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# The stock market and innovative capability in the New Economy: the optical networking industry

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The purpose of this paper is to analyze the impact of the stock market on the innovative capabilities of high-technology companies that have been central to what in the last half of the 1990s came to be called the 'New Economy'. The empirical focus is on equipment suppliers in optical networking—an industry that integrates the bandwidth potential of fiber optics with the data communications potential of the internet. The study covers the period from 1996 to 2003, during which the optical networking industry was, first, central to the New Economy boom, and, then from 2001, ensnared by the bursting of the New Economy bubble. This paper shows how, responding to the New Economy business model brought into the industry by Cisco Systems, three Old Economy companies—Nortel Networks, Lucent Technologies, and Alcatel—sought to use their corporate stock as a currency to acquire technology companies and compensate talented people, and thus accumulate innovative capability. To understand the relation between the stock market and innovative capability in the Cisco 'growth-through-acquisition-and-integration' model and in the 'creative responses' of the Old Economy companies to the Cisco challenge, we apply an analytical framework that links four functions of the stock market—*control*, *combination*, *compensation* and *cash*—with three social conditions of innovative enterprise: *strategic control*—the abilities and incentives of strategic decision makers to allocate resources to uncertain investments in innovative capabilities; *organizational integration*—the structure of incentives that motivates employees to apply their skills and efforts to collective learning processes; and *financial commitment*—the availability to the enterprise of resources to sustain cumulative learning processes until, by accessing markets, they can generate financial returns. Using this framework, we show that the ways in which the Old Economy companies used their stock to accumulate innovative capability in the New Economy boom of 1998–2000 made them more vulnerable to the stock market collapse and the slowdown in the optical networking industry in 2001–2003.

## 1. The Promise of the New Economy

The New Economy of the late 1990s promised sustained growth through the

commercialization of information and communications technology (ICT). In the USA—the home of the New Economy—the previous half-century had seen a massive accumulation of ICT capabilities. The development of computer chips from the late 1950s had provided the technological foundation for the microcomputer revolution from the late 1970s, which in turn had provided the technological infrastructure for the internet boom of the last half of the 1990s. The research funding for this accumulation of ICT capabilities had come mainly from the US government and the research laboratories of established Old Economy high-technology corporations. Each wave of technological innovation, however, generated opportunities for the emergence of start-up companies that were to become central to the commercialization of the new technologies.

The importance of start-ups in the accumulation of ICT capabilities created a much more prominent and, in some ways, different role for the stock market in the US corporate economy than had previously been the case. The Silicon Valley venture capital firms that, by funding semiconductor start-ups from the 1960s helped give the region its name, saw an initial public offering (IPO) as the main way of transforming their ownership positions into returns on their investments. It is no accident that the National Association of Securities Dealers Automated Quotation System (NASDAQ), launched in 1971 and with listing requirements that were (and remain) much less stringent than the New York Stock Exchange (NYSE), became the stock market of choice for venture-backed New Economy firms, including, among the most successful, Intel (founded 1968, IPO 1971), Microsoft (1975, 1986), Apple (1976, 1984), Compaq (1982, 1983), Sun Microsystems (1982, 1986), Dell (1984, 1988) and Cisco Systems (1984, 1990).

To recruit and retain highly mobile technical and managerial employees, young ICT firms offered stock options as partial compensation, with these 'deferred wages' also helping the fledgling companies to conserve cash by paying salaries somewhat below the market rate. In 1982, for example, Microsoft launched a stock option program that applied to all its personnel. When the company went public on NASDAQ four years later, it was primarily to give liquidity to the Microsoft shares that its 1000 or so employees obtained in exercising their options. As companies such as Intel, Microsoft, and Cisco Systems grew large, employees numbering in the tens of thousands were included in their broad-based stock option programs.

At the same time, these companies grew not only through internal expansion but also through acquisitions of smaller companies that had developed new technologies and/or had access to new product markets. Especially in a booming stock market, companies preferred to use their highly valued stock rather than cash as the currency to acquire other highly valued technology companies with highly uncertain revenue prospects. In March 1998, for example, Steve Ballmer, president of Microsoft, articulated the rationale for stock-based acquisitions in recounting how his company responded to Netscape's competitive challenge:

We've had to step up and either make or not make big investments on

internet time. Like WebTV. Like HotMail. Some of them, I think, will prove smart. Maybe some of them won't prove smart. But they're not huge decisions. We have a currency [with our stock price] that makes them relatively small decisions. These deals [WebTV and HotMail] were both done for stock. I still think it's real money, whatever it is—\$400 million or so per acquisition. But I can stop and say, 'OK, that's half of one percent of Microsoft.' That's probably a reasonable insurance policy to pay. (Quoted in Cusumano and Yoffie, 1998, 302, with parentheses in original).

A company's stock came to be an important 'currency' for accumulating innovative capability—both for compensating innovative employees and combining innovative companies. During the New Economy boom, the ability of a high-tech company to use its highly-valued and appreciating stock as a compensation and combination currency appeared to be a potent source of competitive advantage in the accumulation of innovative capabilities. Rapidly rising stock prices became a competitive weapon for innovative companies in their attempts to attract and retain 'talent' and, through acquiring young innovative firms, to gain quick access to new technologies and markets. During the boom, the ebullient stock market seemed to be driving the innovation process.

In a society that had by the 1990s come to accept that 'maximizing shareholder value' was the key to economic prosperity, the stock market appeared to be a central institution in delivering the promise of the New Economy. With the bursting of the New Economy bubble in 2001, however, it became apparent that the boom had been, in large part, a speculative frenzy in which corporate managers faced strong incentives to take actions—in most cases within the letter of the law—to convince public investors of the growth prospects of the stock valuations of the particular companies to which they had inside connections.

What, then, was the relation between the stock market and the accumulation of innovative capability in the New Economy boom? Did the stock market drive innovation, or did innovation drive the stock market? Was the speculative frenzy of the New Economy boom and the consequent disappearance of paper values with the stock market's collapse simply the price that an innovative economy has to pay to mobilize resources to take advantage of fast-breaking technological and market opportunities? Or would the accumulation of innovative capabilities have been better and cheaper, although perhaps slower, had the stock market played a less prominent role in influencing the innovation process? Notwithstanding the collapse in the values of technology stocks as well as the depressed conditions in many sectors of ICT in 2001 and 2002, the stock market remains a prominent economic institution. An analysis of the relation between the stock market and innovative enterprise is important for understanding how advanced economies allocate resources and generate economic growth and the implications for employment stability and income distribution.

Section 2 of this paper provides an overview of the technological, market and competitive conditions that characterize the optical networking industry. Section 3

presents a conceptual framework for analyzing the relation between the stock market and innovative capability. This framework relates what we call the 'social conditions of innovative enterprise' (Lazonick and O'Sullivan, 2000b; O'Sullivan, 2000b; Lazonick, 2002)—encapsulated in the terms *strategic control*, *organizational integration* and *financial commitment*—to the different functions of the stock market—summarized as *control*, *combination*, *compensation* and *cash*—in the business corporation. Using this framework, Section 4 details the functions of the stock market in the New Economy business model developed by Cisco Systems as that company made the transition from enterprise networking to optical networking. Section 5 then summarizes how, as 'creative responses' to the Cisco challenge, Nortel, Lucent and Alcatel sought to make use of the stock market to accumulate innovative capabilities in the period 1998–2000. In Section 6 we consider how, strategically, organizationally and financially, these attempts at transformation rendered the Old Economy companies more vulnerable to the slowdown of industry demand and the collapse of stock prices that occurred in 2001 and 2002. In Section 7 we draw some general implications of our analysis for understanding the relation between the stock market and innovative capability in the economy.

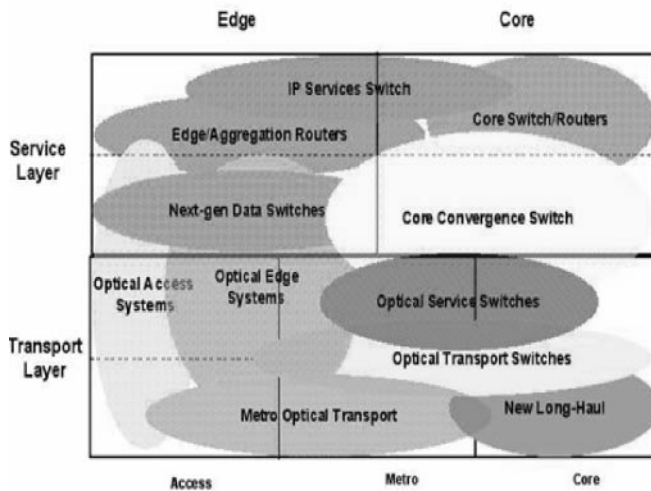
## **2. The optical networking industry: technologies, markets, competitors**

Optical networking seeks to combine the bandwidth, or capacity, advantages of optical fiber with the efficiency advantages of packet-switched networking—the fundamental technology of the internet—in communications systems that can transmit voice, data, and video. As such, optical networking is a relatively new name for the wired segment of the telecommunications industry.<sup>1</sup> Optical networking is an industry that offers enormous scope for technological innovation through the integration of (i) optical transport systems at the network 'core' with access to users of telecommunications services at the network 'edge'; (ii) optical and electronic technologies, or, better yet, the replacement of electronic/optical interfaces with an 'all-optical' or photonic system; and (iii) voice, data and video communications in one high-speed, reliable, secure and cost-effective system that combines wired (optical) and wireless (radio) transmission modes (see Figure 1).

The optical networking industry evolved from the wired segment of the telecommunications equipment industry. As a legacy from the era of national regulation of telecommunications, this segment had long been dominated by the manufacturing arms of national service providers in a circuit-switched carrier system designed for voice transmission. However, with the 'internetworking revolution' of the 1980s and 1990s—culminating in the commercialization and rapid diffusion of the internet—first data transmission and then video transmission over packet-switched

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<sup>1</sup>For readable texts on optical networking technology and systems, see Horak (2000) and Goralski (2001).



**Figure 1** Technological opportunity in the optical networking industry.  
Source: Jander (2002b); adapted from Clavenna and Heywood (2001).

networks became rapidly growing telecommunications markets, and brought New Economy companies into the wired segment of the industry.

The bandwidth requirements of data and video transmission made optical fiber the indispensable transmission mode, and meant that any company, old or new, that wanted to compete in this industry had to accumulate optical capability. Some New Economy companies, most notably Cisco Systems, sought to use their already accumulated capability in producing data networking systems for enterprises as a foundation for developing next-generation systems that could 'converge' the transmission of voice, data and video for public carriers. Other New Economy companies, such as Ciena and Sycamore Networks, sought to enter directly into the development of optical networking products. Meanwhile, the incumbent equipment suppliers' quest to accumulate both data networking and optical capability induced the establishment of hundreds of specialized technology start-ups with a view to being acquired by a major company either before or after an IPO (for a list of some 600 optical networking start-ups in existence in February 2003, see [www.convergedigest.com](http://www.convergedigest.com)).

Networking technology, based on packet switching and routers, enables service providers to make full use of the communications network. During the 1990s different types of switching technologies, most notably Asynchronous Transfer Mode (ATM), were developed to enable packets of data to be transmitted over carrier networks designed for circuit-switched voice transmission. With advances in streaming technology, packet switching was increasingly used for video and voice transmission as well. In the last half of the 1990s the convergence of voice, data, and video transmission over one optical network was still in the process of development. Convergence is now both achievable and, with sufficient volume, cost effective. For example, in October

2002, Telecom Italia inaugurated a 'Voice over IP/MPLS' (Internet Protocol/Multiprotocol Layer Switching) network, based on technology supplied by Cisco Systems and Italtel (the former equipment supplier of Telecom Italia that in July 2000 was acquired by the private equity firm, Clayton, Dubilier & Rice, in combination with Cisco Systems). All voice traffic between Rome and Milan as well as half of Telecom Italia's international voice calls now run over the internet (Hunt, 2002).<sup>2</sup>

While optical technology provides the bandwidth required for data and video transmission, dense wavelength division multiplexing (DWDM), also developed during the 1990s, has vastly increased the number of transmissions that can be made simultaneously over a single strand of optical fiber, thus multiplying the capacity of the installed optical network. Within the optical network, moreover, there has been an ongoing quest to develop an 'all-optical' system, using among other equipment photonic switches that, by avoiding the need to transform signals from photonic into electronic and back again into photonic, would make transmission faster and the system less costly to maintain.

In the USA, the world's largest market for optical networking equipment, the Telecommunications Act of 1996 had opened up competition across manufacturing, local service and long distance.<sup>3</sup> As a result, in the last half of the 1990s, the customers for optical networking equipment were not only incumbent service providers such as, in the USA, AT&T, Bell South, SBC, Sprint, and Verizon but also entrants such as Global Crossing, Level 3, Williams, Broadwing, and Genuity as well as entrant-acquirers, service providers that achieved rapid growth by taking over either incumbent Regional Bell Operating Companies (RBOCs), as in the case of Qwest (which acquired US West), or incumbent long-distance providers, as in the case of WorldCom (which acquired MCI). These 12 US-based providers increased their capital expenditures from \$48.4 billion in 1998 to \$69.4 billion in 1999 and then to \$92.3 billion in 2000 (Harvey, 2002a). The five incumbents accounted for 80% of capital expenditures in 1998 and 65% in 2000, and were to a large extent grafting optical networking capabilities onto legacy circuit-switched voice systems. Meanwhile the entrants, who accounted for 5% of capital expenditures in 1998 and 18% in 2000, were rolling out new optical fiber networks and investing in next-generation equipment, while the entrant-acquirers, with 15% of capital expenditures in 1998 and 18% in 2000, were both upgrading legacy systems and investing in wholly new systems (Harvey, 2002a).

Among the equipment suppliers, Cisco Systems became a major power in data communications by producing internetworking gear for the local area networks (LANs) of companies, schools, hospitals, and government agencies. Incumbent equipment suppliers such as Lucent Technologies (previously AT&T Technologies and

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<sup>2</sup>We are grateful to Maurizio Zollo of INSEAD for supplying us with this reference.

<sup>3</sup>Subsequently, in February 1997, 68 countries that represented over 90% of the global telecommunications market signed the World Trade Organization liberalization agreement (Williams and Cane, 1997).

before 1984 Western Electric), Nortel Networks (previously Northern Telecom and before 1976 Northern Electric), Alcatel (previously part of Compagnie Générale d'Électricité), Ericsson, Siemens, Fujitsu, NEC, and Marconi (GEC renamed in December 1999) had, in the Old Economy, produced primarily for national service providers, although in the 1980s Nortel, based in Canada, had sold equipment to expanding US service providers such as MCI and Sprint, while Alcatel gained access to international markets from the late 1980s through its acquisition of the European operations of ITT. Coming into the 1990s, AT&T Technologies, as a division of AT&T, was the equipment supplier that was most closely tied to a national carrier. In 1996 AT&T divested this technology division, including the famous Bell Labs, so that, as Lucent Technologies, the standalone equipment supplier could compete for different customers. As even the incumbent service providers shed their privileged access to manufacturing capabilities, they called upon the equipment suppliers to deliver not only optical networking systems, be they next-generation or adaptations of legacy infrastructures, but also maintenance and repair capabilities.

Table 1 shows the equipment suppliers' shares of optical transport sales in the North American market in 1999 (total market, \$12.3 billion) and 2000 (total market, \$19.6 billion) as well as in the global market in 2001 (total market, \$28.2 billion, down from \$33.0 billion a year earlier).<sup>4</sup> As can be seen in Table 1, Old Economy telecommunications equipment suppliers have dominated the optical networking industry; in 2001 Alcatel, Lucent Technologies, Nortel Networks, Fujitsu, NEC, Marconi and Siemens had a combined 65% of the global optical transport market. Challenging these incumbents were a number of New Economy companies such as Ciena, with its strength in DWDM; Tellabs, with a niche in digital cross connects; and Cisco Systems, the enterprise-networking giant.

Although Cisco had only 3% of the global market in 2001, it was (and remains) a major force in the industry because of the New Economy business model for the accumulation of innovative capability that it brought from the networking equipment market (which it dominates) into optical networking. Three of the leading Old Economy companies—Alcatel, Lucent and Nortel—responded to the Cisco challenge by using their stock as a compensation and combination currency. In effect, as we shall see, during the height of the New Economy boom, these three companies tried to make the transition from the Old Economy to the New Economy business model.

They sought to make this transition, moreover, in a period characterized by great stock market volatility. During the 1990s the USA experienced the longest stock market boom in its history, so much so that in late 1996, Alan Greenspan, Chairman of the Federal Reserve Board, warned of an 'irrational exuberance' in the markets (Wessel, 1996). Yet two years later, in late 1998, the prices of 'technology' stocks, including those

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<sup>4</sup>RHK has only made public its North American estimates for 1999 and 2000, and its global estimates for 2001. The optical transport network is defined as the market for wavelength division multiplexing, synchronous optical network, and digital cross-connect equipment.

**Table 1** Market shares, optical transport equipment, North American market 1999 and 2000, and global market 2001

Company (country and year company was founded in parentheses)	Percent of total market sales		
	N. American, 1999	N. American, 2000	Global, 2001
Alcatel (France, 1898 as part of CGE)	13	9	16
Lucent (USA, 1872, Western Electric; 1885, AT&T)	24	14	12
Nortel (Canada, 1895 as Bell Canada subsidiary)	29	38	11
Fujitsu (Japan, 1935)	14	12	9
NEC (Japan, 1899)	3	5	6
Ciena (USA, 1992)	2	3	6
Marconi (UK, 1889 as GEC)	0	0	6
Siemens (Germany, 1847)	<1	<1	5
Tyco Telecommunications <sup>a</sup> (USA, 1960)	0	0	5
Tellabs (USA, 1974)	11	10	4
Cisco (USA, 1984)	<1	6	3
Sycamore (USA, 1998)	<1	1	<1
Others	5	2	16

Sources: market shares, RHK press releases, July 19, 2000, July 18, 2001; founding dates, company websites.

<sup>a</sup>Produces submarine equipment.

of optical networking companies, showed a marked acceleration that for most of the companies involved was sustained well into 2000. Briefly, in March 2000, with its adjusted stock price at over \$80 per share, Cisco sported the highest market capitalization of any company in the world. At \$67 per share in early May 2000, Cisco's stock price stood at 130 times what Wall Street estimated its 2000 earnings per share would be. Thomas Donlan (2000: 34), a *Barron's* editor, calculated that to justify this stock price from the point of view of current shareholders, Cisco would have to experience a growth rate in earnings that would increase its 1999 profits of \$2.5 billion to \$2.5 trillion in 2010!

Since then there has been a collapse in the prices of technology stocks, with those of the major optical networking companies among them, as displayed in Figures 2 and 3. Note in Figure 2 the volatility of the 'new economy' NASDAQ Index relative to the Dow Jones Industrial Average (DJIA) and the S&P500 Index, both of which are based largely on the Old Economy stocks of companies listed on the New York Stock Exchange

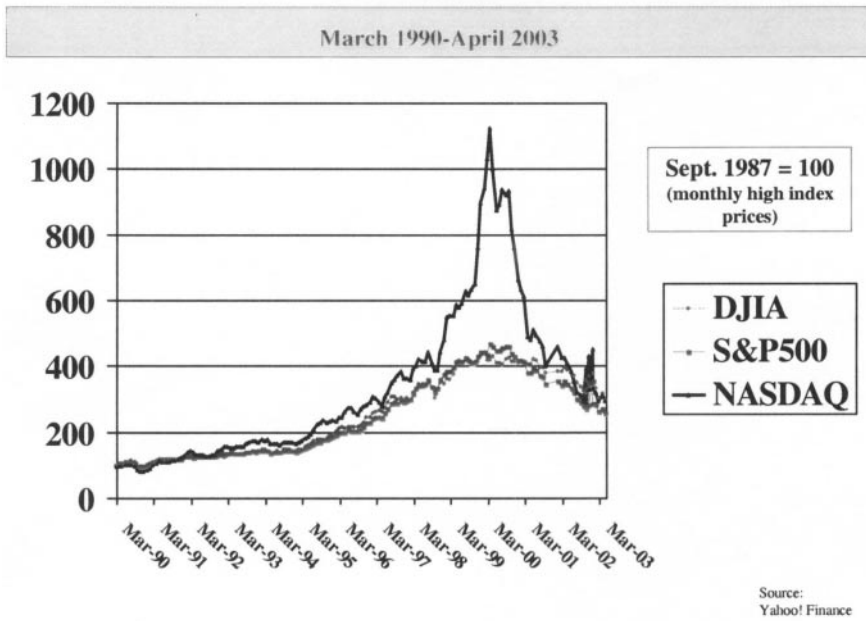


Figure 2 Dow Jones Industrial Average (DJIA), Standard and Poor 500 Index (S&P500) and NASDAQ Index compared.

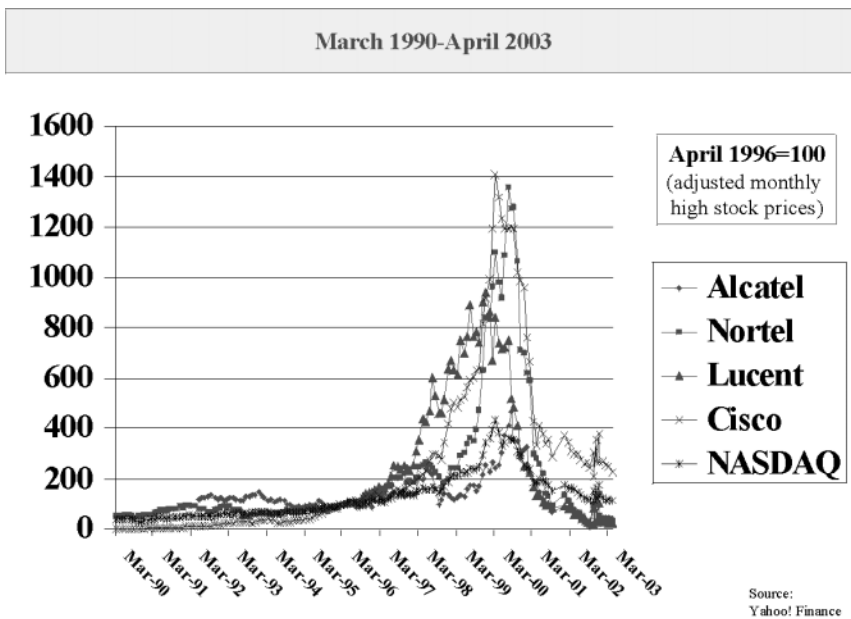


Figure 3 Stock price movements: larger optical networking companies and the NASDAQ Index.

(NYSE).<sup>5</sup> Note also in Figure 3 the even greater volatility than NASDAQ (the bold line) of the stock prices of Nortel and Lucent, which are listed on NYSE, as well as Cisco, which is listed on NASDAQ. Alcatel's stock price (NYSE) followed a trend closer to NASDAQ, and hence was also much more volatile than the S&P500 or DJIA.

### 3. Innovative enterprise and the functions of the stock market

#### 3.1 *Social conditions of innovative enterprise*

An innovative enterprise seeks to transform productive resources into higher quality, lower cost products than had previously been available on the market. To accomplish this innovative transformation, the firm must engage in three generic activities: (i) *strategizing*, through which it allocates resources to strategic investments in human and physical resources; (ii) *organizing*, through which it develops and utilizes the value-creating capabilities of these resources; and (iii) *financing*, through which it can sustain the process of developing technologies and accessing markets from the time at which investments in productive resources are made to the time at which financial returns are generated through the sale of products. Under what conditions do strategy, organization and finance result in innovation? To answer this question requires a conceptualization of the 'social conditions' that endow the enterprise with the types of strategy, organization and finance that, in a given time, place and industry, can result in innovation.

The social condition that can transform strategy into innovation is *strategic control*, defined as a set of relations that gives decision makers the power to allocate the firm's resources to confront the technological, market, and competitive uncertainties that are inherent in the innovation process. For innovation to occur, those who occupy such decision-making positions must have both the incentives and abilities to allocate resources to innovative investment strategies. Their incentives to do so will depend on the alignment of their personal interests with the interests of the business organization in attaining and sustaining its competitive advantage. Their abilities to do so will depend on their knowledge of the current innovative capabilities of the organization over which they exercise allocative control and how those capabilities can be enhanced by strategic investments in new, typically complementary, capabilities.

The social condition that can transform organization into innovation is *organizational integration*, defined as a set of relations that creates incentives for people to apply their skills and efforts to collective learning processes. The need for organizational

<sup>5</sup>Launched in 1896, until November 1, 1999, the Dow Jones Industrial Average was based entirely on NYSE listings. On that date, Microsoft and Intel, both listed on NASDAQ, replaced NYSE-listed companies in the total of 30 companies that make up DJIA ([http://www.djindexes.com/downloads/DJIA\\_Hist\\_Comp.pdf](http://www.djindexes.com/downloads/DJIA_Hist_Comp.pdf)). Currently, the S&P500 Index is made up of 499 companies, of which 74 are listed on NASDAQ, two on the American Stock Exchange and 423 on NYSE ([http://investdb.theglobeandmail.com/invest/investSQL/gx.index\\_component\\_report?pi\\_index=114&pi\\_report\\_type=DETAIL&pi\\_action=%A0Go%A0](http://investdb.theglobeandmail.com/invest/investSQL/gx.index_component_report?pi_index=114&pi_report_type=DETAIL&pi_action=%A0Go%A0)).

integration derives from the developmental complexity of the innovation process combined with the imperative to secure high levels of utilization of innovative investments if the high fixed costs of these developmental investments are to be transformed into low unit costs. Modes of compensation are key instruments for integrating individuals into the organization. To generate innovation, however, a mode of compensation cannot simply manage the labor market—that is, recruit and retain employees; it must be part of a reward system that manages the learning process—that is, motivates employees as individuals to engage in collective learning.

The social condition that can transform finance into innovation is *financial commitment*, defined as a set of relations that ensures the allocation of money to sustain the cumulative innovation process until it generates financial returns. What is often called ‘patient’ capital enables the capabilities that derive from collective learning to cumulate over time, notwithstanding the inherent uncertainty that the innovation process entails. Hence the traditional importance of corporate retentions as a form of ‘inside capital’, often leveraged with long-term debt issues (that is, corporate bonds) or (in some economies) bank debt, to fund the accumulation of capability.

These conditions of innovative enterprise are ‘social’ because, in a particular time and place, the characteristics of strategy, organization, and finance depend on the decisions and actions of economic actors who have different abilities and incentives. Even if the firm were to be an individual actor—an innovative entrepreneur who makes strategy, organizes himself to develop and utilize resources, and mobilizes his own savings to finance the process—one would still need to specify the abilities and incentives of that individual to assess his potential for transforming generic business activities into higher quality, lower cost products. The modern corporate enterprise cannot, however, be analyzed as if it were an individual actor; it employs people numbering in the hundreds, thousands, tens of thousands, or even in some cases hundreds of thousands. These people possess a vast array of specialized abilities that can contribute to company performance, and they have potentially different interests in doing so. The innovation process, moreover, often requires the interaction of people who are employed by different companies that have relations with one another. By focusing on strategic control, organizational integration, and financial commitment as ‘social conditions of innovative enterprise’, we ask how the incentives and abilities of large numbers of people with different hierarchical responsibilities and functional specialties interact to generate products that are higher quality, lower cost than those that had previously been available.

Based as it is on these three social conditions, our approach to innovative enterprise has much in common with the ‘dynamic capabilities’ perspective that seeks to integrate relevant academic research on *asset positions*, *organizational processes* and *evolutionary paths* (Teece *et al.*, 1997; see also Teece and Pisano, 1994; Teece, 2002). Teece *et al.* (1997: 516) stress the importance of learning processes that are ‘intrinsically social and collective’ and argue that ‘strategy involves choosing among and committing to long-term paths or trajectories of competence development.’ The ‘social conditions of

innovative enterprise' perspective asks how and under what conditions the exercise of strategic control ensures that the enterprise seeks to grow using the collective processes and along the cumulative paths that are the foundations of its distinctive competitive success. As indicated by our use of the terms 'control', 'integration' and 'commitment' in the conceptualization of the social conditions of innovative enterprise, our perspective emphasizes the role of human agency in determining whether and how the enterprise accumulates innovative capability. In our framework, 'strategic control' determines how strategic decision makers choose to build on 'asset positions'; 'organizational integration' determines the structure of incentives that characterize 'organizational processes' that can transform individual actions and individual capabilities (including those of strategic managers) into collective learning; while 'financial commitment' determines whether the enterprise will have the resources available to it to persist along an 'evolutionary path' to the point where its accumulation of innovative capability can generate financial returns.

### 3.2 *The functions of the stock market*

Our perspective is also designed to permit the analysis of the influence of national institutions on business organizations in the process of industrial transformation. In particular, we posit that, at a point in time, the governance, employment, and financial institutions that characterize a national economy enable and/or proscribe strategic control, organizational integration, and financial commitment in business enterprises that operate in that national environment.<sup>6</sup> In this paper our analytical interest is in the way in which a particular financial institution—the US stock market—has affected the innovation process in a particular industry—optical networking—at the close of twentieth century and the opening of the twenty-first. To perform this analysis, we require a conceptual framework that specifies the possible functions that the stock market can perform in the industrial corporation, and the relation of these functions to strategic control, organizational integration, and financial commitment.

We identify four functions—classified as *control*, *combination*, *compensation* and *cash*—that the stock market can perform in the industrial corporation. In its control function, the stock market can affect the relation between asset ownership and managerial control in the industrial corporation, and thus affects what types of people occupy positions of *strategic control*. In its combination function, the stock market can provide the industrial corporation with a currency for merging with or acquiring another company, and thus can extend strategic control from one company to a larger strategic entity. In its compensation function, the stock market can provide the industrial corporation with a currency for recruiting, retaining, and motivating personnel,

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<sup>6</sup>Over time, we would expect a dynamic interaction between national institutions and business organizations as new forms of strategic control, organizational integration, and financial commitment contribute to the reshaping of governance, employment, and financial institutions (see O'Sullivan, 2000a; Lazonick, 2003).

and thus can serve as a mechanism for *organizational integration*. Finally, in its cash function, the stock market can provide the industrial corporation with *financial commitment*.

In the transition from the Old Economy to the New Economy in the USA, the functions of the stock market in the industrial corporation underwent a fundamental transformation—indeed, one that, in our view, is central to understanding the difference between the two economic regimes. In the US Old Economy the main function of the stock market was control. Specifically, over the first three decades of the twentieth century, there was an increasingly widespread distribution, and hence fragmentation, of stock ownership in the major industrial corporations listed on the New York Stock Exchange (O’Sullivan, 2000a: ch. 3). As the separation occurred, outsiders to the innovation process become owners of shares, while leaving control over allocation decisions in the hands of salaried managers. Throughout the twentieth century, the stock market continued to perform this control function in the New Economy, but insofar as start-ups tended to list more quickly (see Hobijn and Jovanovic, 2000) and floated only a small tranche of outstanding shares in their IPO (Ritter, 2003: 3), the original owner-entrepreneurs could maintain their positions of strategic control once the company had become a publicly traded corporation.

A comprehensive historical study on the use of stock as a combination currency remains to be done. An advantage of using stock as a combination currency was that, under accounting rules in place in the USA, it enabled a company to treat an acquisition as a ‘pooling of interests’; the enlarged entity accounted for its additional assets at the book value of the acquired company, and thus avoided recording goodwill—the difference between the market value and the book value of the acquisition—as an intangible asset on its balance sheet. By not having to amortize goodwill, the enlarged company would show higher earnings on its profit-and-loss statement over subsequent years than if it had recorded the acquisition at its purchase price. During the conglomerate boom of the 1960s, many pooling-of-interests acquisitions were made with debt or with a combination of securities and cash (Brooks, 1973: 160–161; Editors of *Fortune*, 1970). In 1970, in response to abuses of pooling-of-interests accounting during the conglomerate era, the Accounting Principles Board (replaced in 1973 by the Financial Accounting Standards Board [FASB]), ruled, among other things, that only acquisitions made entirely with common stock could use pooling of interests (Wallman *et al.*, 1999: 26; more generally, Rayburn and Powers, 1991; Seligman, 1995: 419–429).

The New Economy boom of the 1990s raised the value of shares relative to cash, thus making stock a relatively more attractive combination currency. Pooling-of-interests accounting made stock-based acquisitions especially advantageous to reported earnings when, as we shall see in the optical networking industry, established companies were bidding for relatively young companies—indeed in some cases revenue-less start-ups—with low book values. It may well be for these reasons that the use of stock instead of cash as an acquisition currency was much more prevalent in the USA in the late 1990s than it had been during the late 1980s (Rappaport and Sirower, 1999; see also Tufano,

1993: 290). In their *Harvard Business Review* article entitled 'Stock or cash?', Alfred Rappaport and Mark Sirower (1999: 147–148) argue:

The legendary merger mania of the 1980s pales beside the M&A activity of this decade. In 1998 alone, 12,356 deals involving U.S. targets were announced for a total value of \$1.63 trillion. Compare that with the 4 066 deals worth \$378.9 billion announced in 1988, at the height of the 1980s merger movement. But the numbers should be no surprise. After all, acquisitions remain the quickest route companies have to new markets and to new capabilities. As markets globalize, and the pace at which technologies change continues to accelerate, more and more companies are finding mergers and acquisitions to be a compelling strategy for growth. What is striking about acquisitions in the 1990s, however, is the way they're being paid for. In 1988, nearly 60% of the value of large deals—those over \$100 million—was paid for entirely in cash. Less than 2% was paid for in *stock*. But just ten years later, the profile is almost reversed: 50% of the value of all large deals in 1998 was paid for entirely in *stock*, and only 17% was paid for entirely in cash.

The collapse of stock prices that occurred in late 2000 and the first half of 2001 led to widespread criticism of pooling of interests, and in July 2001 FASB banned the further use of this method of accounting for acquisitions.<sup>7</sup>

The use of stock as a compensation currency for top executives of US corporations became widespread in the 1950s after the Revenue Act of 1950 ruled that under fairly liberal conditions an employee could be taxed at the capital gains rate rather than the much higher personal income rate on the benefit from a stock option and did not have to pay tax on the gain until the stock was sold (Bomeli, 1962; Lewellen, 1968, 1971).<sup>8</sup> The microcomputer revolution of the early 1980s, with its open architectures and opportunities for start-ups, had led firms to use stock options to recruit and retain highly mobile 'talent'. It became a common practice for New Economy companies that did high-end design work but little manufacturing to have broad-based stock option plans that extended to virtually all employees, a very high percentage of whom were highly educated, and hence highly mobile on the labor market. From the early 1980s, therefore, New Economy companies used stock options to attract and retain, and ostensibly to motivate, not only executives but also substantial numbers of non-executive personnel.

A US Department of Labor pilot survey in 1999 showed that, for publicly listed companies, 27% of non-executive employees with incomes of \$75 000 and over had stock options (US Bureau of Labor Statistics 2000). A survey of a 'near-constant'

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<sup>7</sup>FASB news release: <http://accounting.rutgers.edu/raw/fasb/>

<sup>8</sup>For a primer on stock option tax law, see <http://taxes.yahoo.com/guide/excecomp/>

sample of 350 US-based companies in 1993 and 1999 showed that the proportion that had made provision for broad-based plans increased from 17.4% to 39.4%, while the proportion that actually made grants under these plans increased from 5.7% to 18.0% (Sabow and Milligan 2000: 100). Another survey of the top 200 US industrial and services companies by sales revealed that 7.5% of their outstanding shares were authorized for stock option plans in 1990 and 15.2% in 2000 (Pearl Meyer & Partners, 2001). Besides the spread of stock options to non-executive employees that these figures reflect, stock options also figured prominently in the compensation of the top executives of these companies. Between 1980 and 1994 the mean value of stock option grants to chief executive officers (CEOs) of about 400 of the largest US corporations rose from \$155 037 to \$1 213 180, or by 683%, while the mean value of their salary and bonus compensation rose from \$654 935 to \$1 292 290 million, or by 95%. As a result, in 1980 stock options accounted for 19% of the mean direct compensation of CEOs; in 1994, 48% (Hall and Leibman, 1998: table IIa). In 2000, according to the Pearl Meyer survey of the top 200 US corporations, average CEO compensation was \$11.3 million, of which 60% was from stock options and 9% from salary (Pearl Meyer & Partners, 2001).

Over the course of the twentieth century, compared with retentions and bonded debt, the stock market has been of limited importance as a source of cash for US corporations, although the aggregate data hide important cross-industry and cross-company differences in the use of the stock market to raise cash at different points in time. The most important period of fundraising on the stock market for US corporations was in the speculative boom of the late 1920s when many major corporations took advantage of high stock-market valuations to restructure their balance sheets—that is, to pay off debt or to bolster the corporate treasury—an exercise in financial engineering that made these companies less vulnerable to the dramatic downturn in the economy in the 1930s than they would otherwise have been. Since the 1980s, while many young companies have raised substantial funds in their initial public offerings (typically listing on NASDAQ), many established US corporations have become purchasers of their own stock (O’Sullivan, 2003). For many companies, repurchases were simply a way of trying to boost their stock prices. But by the 1990s some of the most successful New Economy companies such as Intel and Microsoft, while paying little if any dividends, became large-scale repurchasers of their own stock in order to offset dilution of shareholdings as a result of their broad-based stock option programs and stock-based acquisition strategies. For example, over fiscal years 1997–2000, Microsoft (with 20 561 employees at the beginning of the period and 39 100 at the end) repurchased stock valued at \$13.4 billion (by way of comparison over the same period the company spent \$11.2 billion on R&D) (*Microsoft Annual Reports*).

The rise of the New Economy, therefore, placed much more emphasis on the role of the stock market in the industrial corporation, particularly in terms of the stock market’s functions as a combination currency and compensation currency to accumulate innovative capability. This greater reliance on the combination and compensation functions of the stock market in turn placed pressure on companies to do stock re-

purchases, and thus become suppliers of cash to the stock market rather than the stock market being a supplier of cash to these corporations. The following sections of this paper analyze the evolution of the functions of the stock market in the optical networking industry, first at Cisco and then at the Old Economy companies, Nortel, Lucent and Alcatel, that sought to adopt the Cisco model, followed by a consideration of the impact of the stock market on the innovative capability of these industrial corporations.

## 4. The new economy business model

### 4.1 *Cisco Systems: from internetworking to optical networking*

A number of management case studies and books as well as innumerable press and magazine articles have documented Cisco's rise from Silicon Valley start-up in 1984 to its IPO in 1990 followed by a decade of phenomenal growth in which it came to dominate the market in internetworking equipment (see O'Reilly, 1998; Tempest *et al.*, 1998; Bunnell, 2000; Morgridge and Heskett, 2000; Paulsen, 2001; Young, 2001). Cisco's main business is the manufacture of the equipment and systems for the routing of packets of data through the local area networks (LANs) of enterprises and the connection of these LANs to metropolitan area networks (MANs) covering large urban areas, which in turn connect with wide area networks (WANs) that cover different cities, regions and nations. During the last half of the 1990s, as telecommunications carriers invested in infrastructure and equipment for the integration of voice, data, and video transmissions in high-bandwidth optical networks, Cisco entered the optical networking industry, thus bringing it into direct competition with Old Economy telecommunications equipment companies such as Lucent, Nortel and Alcatel.

Founded in 1984, Cisco Systems grew out of a project undertaken by two computer specialists at Stanford University to enable computers located in different parts of the campus to communicate with one another. In the 1990s the 'multi-protocol' router, Cisco's core technology, provided the basis for the functioning of the world wide web, and placed Cisco at the center of the internet revolution. By 1997 Cisco could claim over 76% of the global router market (Morgridge and Heskett, 2000). The company has described itself as 'the worldwide leader in networking for the internet', and its stated goal is to be the number one market player in the three key customer segments it serves—enterprise, service provider and commercial—'as they move toward integrated data, voice and video networks' (*Cisco Systems Annual Report*, 2001: 9).

In 1990, the year of its IPO, Cisco had annual revenues of \$70 million and 254 employees (up from \$1.5 million and 10 employees three years earlier). By 2001 the company had revenues of over \$22 billion and 38 000 employees (see Table 2). As its revenues and labor force have grown, the company has become increasingly engineering- and R&D-intensive, and increasing proportions of its workforce and business are outside of the USA.<sup>9</sup>

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<sup>9</sup>In 2002 the Americas accounted for 57.1% of Cisco's revenues; EMEA (Europe, Middle East and Africa), 26.5%; Asia Pacific, 9.8%; and Japan, 6.8% (*Cisco Systems 2002 Annual Report*: 14).

**Table 2** Cisco Systems, revenues, income, R&D and employment, 1990–2002

Year	Net sales (\$m)	Net income (\$m)	R&D as % of sales	No. of employees	% M&C <sup>a</sup>	% S&M <sup>b</sup>	% ENG <sup>c</sup>	% F&A <sup>d</sup>	% non-US <sup>e</sup>
1990	70	14	8.84	254	42.9	20.9	20.9	11.4	3.9
1991	183	43	6.93	505	40.2	21.8	19.0	10.9	8.1
1992	382	84	7.87	882	29.5	25.9	22.9	13.3	8.5
1993	715	172	6.19	1451 <sup>f</sup>					
1994	1334	323	7.99	2443	22.1	23.2	23.2	11.3	14.2
1995	2233	456	9.44	4086	23.3	26.7	24.9	9.9	15.2
1996	4096	913	9.75	8782	24.5	38.6	27.6	9.4	15.9
1997	6440	1049	10.84	11 000	20.0	40.9	30.1	8.2	18.2
1998	8458	1331	12.06	15 000	20.0	42.0	30.0	8.0	20.0
1999	12 173	2023	13.66	21 000	18.6	41.0	33.3	7.1	21.0
2000	18 928	2668	14.29	34 000	17.7	41.2	32.3	8.8	26.5
2001	22 293	-1014	17.59	38 000	18.4	39.5	34.2	7.9	29.0
2002	18 915	1893	18.23	36 000	16.7	38.9	36.1	8.3	27.8

Source: *Cisco Systems Annual Reports* (fiscal years ending last week in July).

<sup>a</sup>Manufacturing and customer service employees.

<sup>b</sup>Sales and marketing employees.

<sup>c</sup>Engineering employees.

<sup>d</sup>Finance and administration employees.

<sup>e</sup>Employees located outside the USA (also included in occupational categories).

<sup>f</sup>Breakdown of employees by category of employment not available for this year.

While Cisco has become a competitor in producing optical networking equipment for service providers, its major base remains in supplying internetworking equipment to enterprises (including those in the government sector). Cisco currently classifies its revenues into products and services, and among products includes four segments: routers, switches, access and other. In 2002 the router segment—the company's original business—accounted for 30% of Cisco's revenues, while the switching business, which Cisco entered in 1993 with its acquisition of Crescendo, accounted for 40%. Access products, which included ISDN remote access routers, dialup access servers, wireless solutions, and DSL technologies, brought in 7% of the company's revenues. The 'other' product segment includes optical networking equipment that Cisco sells in both enterprise and service provider markets as well IP telephony, internet network service and security, and network management software. UBS Warburg estimated that service providers generated between 10 and 15% of Cisco's earnings in 2002, and predicted

that, given the probability of on-going spending cuts by carriers, Cisco would only increase those revenues by 1% in 2003 (Reardon, 2002).

Cisco's future in optical networking depends on a shift of incumbent carriers from circuit to packet technology, which will await a resurgence of capital expenditure in the industry. In late 2002 Mike Volpi, Cisco's senior vice president for the routing technology group, observed:

There isn't a carrier out there that isn't spending money on circuit technology right now. But there also isn't one that would debate that packet technology is the future. . . . Not only is there less money being spent, but we have to work harder to increase the portion of money that is allocated to new technology like ours. But if you look at the circuit switching guys [such as Nortel, Lucent and Alcatel], they're the ones who are hurting right now. (Reardon, 2002)

As we shall see, Cisco has been accumulating optical networking capability since 1996, and during the New Economy boom the company brought a new business model into the optical networking industry that Old Economy companies such as Nortel, Lucent and Alcatel felt that they could not ignore. Central to this business model was the use of stock as a currency to accumulate innovative capability. An understanding of the four functions of the stock market in Cisco's evolution illuminates both the critical characteristics of the New Economy business model and the challenge that it posed to Old Economy competitors.

#### 4.2 *The functions of the stock market*

*Control.* Cisco Systems was founded in 1984 by the husband-and-wife team of Leonard Bosack and Sandy Lerner, both employed at the time at Stanford University, Bosack in computer science and Lerner at the business school (Bunnell, 2000: ch. 1). Bosack and Lerner started Cisco to commercialize a router that enabled computers to communicate with one another in a local area network. In 1987, with 10 employees, they received \$2.5 million as their first round of venture capital from Donald Valentine of Sequoia Capital, who still sits on Cisco's board as vice-chairman. In 1988 Valentine brought in John Morgridge, who had been the CEO at Grid Systems, the manufacturer of a portable computer, to head the company. In February 1990 the company went public, issuing 2.8 million shares (equal to 21% of the shares outstanding in July 1990) for a net sum of \$47.4 million (*Cisco Systems 1990 10-K*: 18).<sup>10</sup> As Morgridge hired more professional

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<sup>10</sup>Throughout this paper, 10-K refers to the Form 10-K Annual Report filed by corporations with the US Securities and Exchange Commission (SEC); 10-Q refers to Quarterly Form 10-Q Reports filed with the SEC; 20-F refers to the annual report that foreign companies (in this study only Alcatel since Nortel has a registration as a US as well as Canadian company) file with the SEC; 8-K refers to the 'current report' of any material events or corporate changes which are of importance to investors or security holders and previously have not been reported by the registrant in a 10-K or 10-Q; and Proxy

managers to run the prospering company, conflicts arose with Lerner, and by November 1990 Lerner and Bosack were no longer managers in the company.<sup>11</sup> The couple left owning some 27% of the outstanding shares, which they subsequently sold for about \$170 million (Clark, 1991a, 1991b, 1993). This exit of the founding entrepreneurs effectively separated asset ownership from managerial control.

The current CEO, John Chambers, joined the company as vice president of worldwide sales and operations in 1991, when Cisco had revenues of \$183 million and about 500 employees. In 1995 Chambers took over the top executive position from Morgridge, who, in 2002, remained chairman. With 7.3 billion million shares of common stock outstanding on July 27, 2002, Chambers owned 26.4 million shares (0.36% of the total), Morgridge 83.5 million shares (1.14%) and Valentine 2.6 million shares (0.04%) (*Cisco Systems 2002 Proxy Statement*: i, 12). These three men are very influential at Cisco, and through their association with the company—Valentine as the main venture capitalist and Morgridge and Chambers as well-compensated executives—they have become very rich. All three are, however, fundamentally managers, not owners.

The outside ownership of Cisco is widely dispersed, with about two-thirds of the company's shares in the hands of almost 3900 institutional investors, including mutual funds, and with a total of 81 058 registered shareholders as of July 27, 2002 (*Cisco Systems 2002 Annual Report*: 50). In 2002 the 10 financial institutions with the largest Cisco shareholdings accounted for 19.72% of the company's outstanding stock (the largest single holder was Barclay's Bank plc, with 3.58%), while the top ten mutual funds held 13.79% (the largest single holder was Bankhaus Schelhammer & Schattera-Superior 4, with 6.92%).<sup>12</sup>

*Combination.* Central to Cisco's emergence as the dominant company in networking equipment and as a competitor in optical communications has been a 'growth-through-acquisition' strategy, launched in 1993. From September 1993 through March 2003 Cisco made 79 acquisitions (see Table 3). Cisco used its own shares rather than cash as the only acquisition currency in all but nine of the purchases. In only four cases—Lightstream (\$120 million in 1994), Telebit (\$196 million in 1996), Global Internet Software (\$40 million in 1997) and Internet Engineering Group (\$25 million in 1999)—was the payment for acquisitions entirely in cash.

As can be seen in Table 3, the rate at which Cisco made acquisitions accelerated sharply in 1999 and 2000, with 41 of the company's 79 acquisitions having been made in these two years. At the same time, the average price that Cisco paid for acquisitions on a per-employee basis also rose sharply in 1999 and 2000, in part because it was paying for these acquisitions in shares that had highly inflated prices and in part because of an

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Statement refers to the report, filed with the SEC, that is sent to shareholders in advance of the company's Annual General Meeting.

<sup>11</sup>'Cisco Systems reports first quarter earnings,' *Business Wire*, November 7, 1990.

<sup>12</sup>*Yahoo! Finance*. The holdings of the financial institutions were as of September 30, 2002; the holdings of the mutual funds were as of dates ranging from April 30, 2002 to September 30, 2002.

**Table 3** Cisco System's acquisitions, 1993–2003

Calendar year	No. of firms acquired	Total value (\$m)	Average value (\$m)	% paid in shares	Target employees	Value per employee (\$m)	Target/Cisco employees (%) <sup>a</sup>
1993	1	89	89	100.00	60	1.48	4.1
1994	3	423	141	71.63	320	1.32	13.1
1995 <sup>b</sup>	4	672	168	100.00	205	3.27	5.0
1996 <sup>c</sup>	7	5550	793	96.46	1547	3.59	17.6
1997 <sup>d</sup>	6	586	98	70.85	210	2.79	1.9
1998	9	1114	124	99.85	722	1.54	4.8
1999	18	14 435	802	99.83	2363	6.11	11.3
2000 <sup>e</sup>	23	12 254	533	98.80	2007	6.11	5.9
2001	2	331	166	100.00	91	3.64	0.2
2002 <sup>f</sup>	4	389	97	100.00	418	0.93	1.2
2003 <sup>g</sup>	2	654	327	100.00	360	1.82	
Total	79	36 497	462	98.19	8303	4.40	

Sources: Compiled from press releases on [www.cisco.com](http://www.cisco.com) and news reports.

<sup>a</sup>Calculated as proportion of total number of people employed by target companies during the calendar year that they were acquired divided by the number of Cisco employees at the end of its fiscal year (last week in July).

<sup>b</sup>Acquisition cost of Network Translation, with 10 employees, not disclosed.

<sup>c</sup>Acquisition cost of Metaplex, with 19 employees, not disclosed.

<sup>d</sup>Acquisition cost of Telesend, with 10 employees, not disclosed.

<sup>e</sup>Number of employees at Exio Communications, acquired for \$155 million in stock, not disclosed.

<sup>f</sup>Not including Andiamo, a 270-person company in which Cisco has a stake, whose acquisition for a 'maximum purchase price' of \$2.5 billion was announced in 2002 but which is to be completed in 2004.

<sup>g</sup>Through March 2003 only.

intense competition among optical networking companies to acquire new technology and access new markets. In 1993 Cisco made its first acquisition, Crescendo, a company with \$10 million in revenues and 60 employees, for \$89 million in shares that absorbed 1.24% of Cisco's stock outstanding.<sup>13</sup> In 1999 Cisco made its 39th acquisition, Cerent, a company with \$10 million in revenues and 287 employees, for \$6.9 billion in shares that

<sup>13</sup>These figures on the percentage of stock entailed in an acquisition include stock required to assume the acquired company's stock option plan.

absorbed 2.93% of its stock outstanding. Among Cisco's other most expensive acquisitions, StrataCom, with 1208 employees (by far the most of any of Cisco's acquisitions), cost \$4.8 billion in 1996 and absorbed 12.38% of Cisco's stock outstanding; while Arrowpoint, with 337 employees, cost \$5.7 billion in 2000, and absorbed 1.32% of Cisco's stock outstanding.

In 1998 Volpi, then vice-president of business development, explained Cisco's acquisition strategy as a 'generic process'. 'Sometimes in all this speed,' he recognized, 'we pay too much. But the acquisitions are not financial—we don't do them because we can swing a good deal—they are strategic. We do them to grow the company in the right direction' (O'Reilly, 1998: 9). In 2002 Volpi, who had since become senior vice president of Cisco's Router Technology Group, explained that what he meant by 'the right direction' was to use acquisitions to enter new markets rather than to build share in existing markets. He argued that in 'the environment we live in right now, it's very difficult to identify growth markets. There are very few. And when you cannot pinpoint your growth markets, you can't use the tool—the M&A tool' (Harvey, 2002d).

For the sake of successful integration, Cisco has favored the acquisition of companies that have been in close proximity to their main centers of operation; 57% of the companies that Cisco has acquired have been based in Northern California. For 66 of the 71 companies that Cisco acquired through 2000, Mayer and Kenney (2002: 7) found that 43 were already shipping a product prior to acquisition while the other 23 still had their initial products under development (no information was available on the other five acquisitions). For an acquisition that has a commercializable product, Cisco's goal is to have the product appear on its price list from the day the acquisition closes. With access to Cisco's sales organizations and value added resellers, volume sales of the acquired company's products generally increase immediately by a multiple of between two and five. At the same time, however, Cisco also claims that, given the rapid pace of technological change in its industry, it will not acquire a company simply to get access to a specific product; rather, its goal is to only acquire companies whose capabilities will enable Cisco to generate a succession of new products over the longer term. Chambers has claimed that 'when we acquire a company, we aren't simply acquiring its current products, we're acquiring the next generation of products through its people. If you are paying between \$500 000 and \$3 million per employee, and all you are doing is buying the current research and the current market share, you're making a terrible investment' (Daly, 1999).

Top executives of acquired companies must enter into 'golden handcuff' agreements that for a two-year period after the acquisition they will not start or join a company that is in competition with Cisco (O'Reilly, 1998: 6). When Cisco acquires a company, it hires all its personnel, and takes over its stock option program; indeed Cisco claims that it will refuse to acquire a company whose stock-based compensation system is not compatible with its own. As shown in Table 3, over the past decade the number of employees from acquired companies who have had to be integrated into Cisco has varied considerably from year to year, both absolutely and as a proportion of existing

Cisco employees. Each new employee from an acquired company is assigned a Cisco 'buddy' whose role it is to explain the company's systems and procedures. The rapid pace of acquisition activity, combined with rapid growth of the number of Cisco employees more generally, has mitigated the tendency for the creation of 'old' and 'new' employee groups that would obstruct the integration process. Not all employees who have joined Cisco through the acquisition process 'fit the Cisco culture', but Cisco has been particularly successful in retaining executive management from the companies it has acquired. According to the recent study by Mayer and Kenney (2002: 12), half the chief executives and over 70% of the senior management of the companies that it has bought have remained with Cisco.<sup>14</sup>

Cisco has regularly been voted among *Fortune* magazine's '100 Best Companies to work for in America', placing 25th in 1998, 24th in 1999, 3rd in 2000 and 2001, 15th in 2002, and 24th in 2003.<sup>15</sup> Cisco's voluntary attrition rate among employees is remarkably low for a Silicon Valley high-tech company; in the early stages of the New Economy boom, Tempest *et al.* (1998: 2) cited a 6% voluntary attrition rate, while O'Reilly (1998: 7) cited a 13% turnover rate. More recently, Mayer and Kenney (2002: 10) found that 'on an annualized basis as of 2001, 100% of [the 44 of Cisco's] acquisitions [for which the company provided data] had an overall annual turnover rate of under 10 percent . . . and 95 percent had an annual turnover rate among engineers of under 10 percent.' They also show that the highest turnover rates of engineers from acquired companies occurred in acquisitions done between 1998 and 2000 (Mayer and Kenney, 2002: 11).

Cisco's move into producing carrier-class equipment for optical networks began with its \$4.7 billion acquisition of StrataCom in 1996, 'a leading supplier of Asynchronous Transfer Mode (ATM) and Frame Relay high-speed wide area network (WAN) switching equipment that integrates and transports a wide variety of information, including voice, data, and video'. Cisco claimed that the StrataCom acquisition would enable it 'to provide end-to-end solutions across public, private, and hybrid networks', and to 'define the future of networking by merging high-performance ATM switching and local area network (LAN) switching with the intelligence and control of routing to develop next-generation networking infrastructure'.<sup>16</sup> Despite the insistence of IP purists in the mid-1990s that the best way to move data was via routers, ATM equipment offered the advantage of having been designed to fit into the bays and slots of incumbent phone companies' legacy voice systems, while enterprise clients were ordering ATM to avail themselves of bulk data purchasing directly from carriers (see Young, 2001: 180–193, on which the following draws).

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<sup>14</sup>According to Mayer and Kenney (2002: 12): 'As of May 2001, eight Crescendo Alumni were vice presidents or higher at Cisco. Four Senior Vice Presidents and 14 Vice Presidents came from the first 8 acquisitions. We identified 35 vice presidents or higher recruited through acquisition.'

<sup>15</sup>The *Fortune* list, which was inaugurated in 1998, is published in January each year.

<sup>16</sup>'Cisco Systems to join with StrataCom,' Cisco Systems press release, April 22, 1996.

Cisco's next significant move into optical networking came with the December 1998 acquisition of PipeLinks, a company (in which Cisco had been a minority shareholder since 1997) that had developed SONET/SDH routers that could simultaneously transport circuit-based traffic and route IP traffic.<sup>17</sup> Founded in 1996, PipeLinks employed 73 people when acquired and cost Cisco \$123 million in shares. The Pipelinks technology was seen as a way of enabling service providers to supply internet services while continuing to use their existing SONET/SDH infrastructures.

Cisco's biggest move into optical technology was in August 1999 when it acquired, for \$6.9 billion in stock, Cerent, a 287-person company that had been founded in 1997. Cisco described Cerent as 'a leading developer of next-generation optical transport products' that, by permitting data traffic to be grafted onto older SONET networks, would 'allow service providers to transition to New World data and voice networks'. At this point, Nortel held a dominant market share in the long haul and metro networks for such products. On the same day that it announced the Cerent acquisition, Cisco also announced that it was acquiring Monterey Networks (founded in 1997, 132 employees) of Richardson, Texas for approximately \$500 million in stock. Monterey was described as 'an innovator of infrastructure-class, optical cross-connect technology that is used to increase network capacity at the core of an optical network'. Both Cerent and Monterey Networks were integrated into Cisco's Transport Group. According to Cisco, these two acquisitions nearly doubled 'the number of employees focusing on the optical space to bring the total to approximately 900'.<sup>18</sup>

In December 1999, Cisco moved even further from California when it announced the acquisition of the optical systems business of the Italian company, Pirelli S.p.A. for \$2.15 billion in stock. Pirelli Optical Systems had 701 employees, with plants in Italy, France, Germany and South Carolina. The purpose of the acquisition was to enable Cisco to enter the DWDM market. In connection with this acquisition, Cisco announced its intention to invest over \$100 million in Pirelli's optical components and submarine optical transmission system business. Given the optical networking acquisitions that it had already made, Cisco saw the Pirelli acquisition as key to its ability to provide optical systems to service providers:

The acquisition of Pirelli Optical Systems enables Cisco to offer an end-to-end optical networking solution for service providers. Pirelli's optical products will be seamlessly integrated with optical products and technology that Cisco has acquired from start-ups Cerent, Monterey

<sup>17</sup>Cisco Systems to acquire Pipelinks, Inc.,' Cisco Systems press release, December 2, 1998. SONET (synchronous optical network) is the standard for synchronous (i.e., all information sent at the same clock rate) data transmission on optical media set by the American National Standards Institute while SDH (synchronous digital hierarchy) is the international equivalent first adopted as the standard in Europe.

<sup>18</sup>Cisco Systems to acquire Cerent Corporation and Monterey Networks for combined \$7.4 billion,' Cisco Systems press release, August 26, 1999.

Networks and Pipelinks. While these optical businesses are combined with Cisco's leadership in internet routing, the acquisition of Pirelli's optical business allows Cisco to immediately address the total optical networking market estimated to be over \$40 billion in 2005.<sup>19</sup>

Cisco claimed that Pirelli was the first company to ship open standards-based, 10 Gbps optical transport systems (also known as OC-192), 'the most advanced high-speed fiber optic technology used in next-generation optical networks'. Pirelli counted France Telecom, Telecom Brazil, Global Crossing and Deutsche Telekom among its customers for DWDM; according to Cisco, Pirelli had 'the largest installed base for such products in the world'.<sup>20</sup>

Cisco made another European-based optical acquisition in May 2000, when it paid approximately \$800 million for Qeyton Systems, a 52-person, privately held firm based in Stockholm. Cisco described Qeyton as 'the developer of Metropolitan DWDM technology to optimize the performance and cost requirements of service providers' metropolitan networks', and proclaimed that the acquisition 'underscores Cisco's commitment to building internet scale, carrier-class, optical networks for the service provider market'.<sup>21</sup>

Clearly, over the past decade acquisitions have been important to Cisco's growth. According to a 1999 *Fortune* article on Cisco's acquisition strategy, Crescendo, the company's first acquisition, which cost \$89 million in stock, 'is the foundation of a unit that generates about \$4 billion in revenue annually' (Goldblatt, 1999). Having taken strategic control of the acquired companies, however, the key to Cisco's success has been the integration into the Cisco organization of those people who have constituted much of the capability of these companies. On this foundation, Cisco has been then able to develop more complex products in-house as part of a proprietary communications system (see, for example, Harvey 2002b). Hence the explosion of Cisco's R&D as a proportion of sales from an average of 7.2% in 1991–1994 to 10.5% in 1995–1998 and to 15.9% in 1999–2002, with a trend that has been continuously upward since 1993, the year of its first acquisition (see Table 4).

In large part as a result of absorbing and building upon the R&D capabilities of the companies that it has acquired, by the late 1990s the proportion of sales that Cisco spent on R&D compared favorably with that of its main rivals in optical networking. Indeed, in 2001 its absolute level of spending on R&D surpassed that of Lucent, Nortel and Alcatel, as was even more the case in 2002 as Lucent and Nortel in particular slashed their R&D budgets. At the same time, Cisco's very different structure of employment (it does virtually no manufacturing) meant that its expenditures on R&D per employee far surpassed those of its rivals (see Table 4). Relative to its R&D budget, however, Cisco

<sup>19</sup>'Cisco Systems to acquire Pirelli Optical Systems,' Cisco Systems press release, December 20, 1999.

<sup>20</sup>*Ibid.*

<sup>21</sup>'Cisco Systems to acquire Qeyton Systems,' Cisco Systems press release, May 12, 2000.

**Table 4** R&D spending and patenting at Cisco, Lucent, Nortel and Alcatel

	2001 R&D expenses, \$ millions	R&D % of sales	Per employee \$ millions	Total US patents, 1996–2002	US optical patents, 1996–2002
Cisco	3922	17.6	71.3	643	160
Lucent	3520	16.5	31.4	6478	2250
Nortel	3224	18.4	31.6	2123	626
Alcatel	2731	12.2	19.0	2102	854

Sources: R&D data: Company financial reports. Patent data: <http://patft.uspto.gov> (searching in field name 'Description/Specification' for 'optic\$').

does much less patenting, both overall and in optical, than Lucent, Nortel and Alcatel. Hence the common notion that the accumulation of capabilities in the Cisco model is more aptly described as a process of 'acquisition and development'.

*Compensation.* At the end of the 1990 fiscal year, Cisco's first as a publicly listed company, it had 254 regular employees (as well as 30–45 part-time and contract workers at any one time during the fiscal year). By July 1993, prior to its first acquisition, the number of regular Cisco employees had risen to 1451 (plus 83–165 temporary and contract employees) (see Table 2). Between 1993 and 1996 the number of Cisco regular employees saw a sixfold increase, and then between 1996 and 2001 an additional fourfold plus increase. In April 2001 Cisco announced its first job cuts, numbering 8500, although only 5400 were actually terminated (*Cisco Systems 2002 Annual Report*: 35), with the layoffs focusing on employees in the 'manufacturing and customer service' and 'sales and marketing' categories. By the end of July 2001 Cisco had 38 000 regular employees on its payroll, and a year later 36 000 (*Cisco Systems 2002 10-K*: 11).

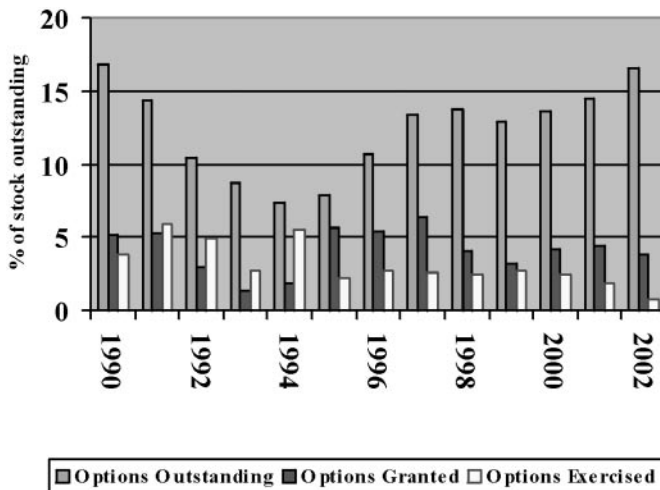
Like any major business organization, be it Old Economy or New Economy, Cisco compensates its professional, technical, and administrative employees according to hierarchical position, function and experience. Characteristic of a New Economy company, Cisco employs no 'hourly' workers; it outsources most of its manufacturing operations and none of its own employees have union representation. Also characteristic of a New Economy company, and especially one with its base in Silicon Valley, Cisco offers stock options as a form of remuneration to all its regular employees.<sup>22</sup> Given the almost uninterrupted upward movement of Cisco's stock price from the time of its IPO in February 1990 until its peak in March 2000, many Cisco

<sup>22</sup>According to data reported sporadically in Cisco's *Proxy Statements*, in 1992, 1993, and 1998, 100% of regular employees were eligible for the Discretionary Stock Option Plan, while the proportion eligible in 1994 was 93% and in 1995 94%.

employees besides top executives have become millionaires, at least on paper. It was claimed that in 1997 about 800 Cisco employees were (paper) millionaires and in March 2000, and when Cisco's share price peaked, there were some 4000 (Avery, 2000).

Cisco introduced its first broad-based stock option program in 1987. One year from the grant date, 25% of options could be exercised, with the remainder being exercisable in equal proportions over each of the next 36 months. The options expired ten years after their grant date. In 1996, a new stock option plan was introduced that lengthened the vesting period for new options from four to five years while shortening the expiration date of options to nine years. In 1997 Cisco added a relatively small, non-shareholder approved, Supplementary Stock Incentive Plan, for which Cisco officers and directors are ineligible, presumably to give it flexibility in offering highly mobile technical and managerial personnel added incentives to stay with the company. Since 1989 Cisco has also had an employee stock purchase plan that enables eligible employees to have up to 10% of their cash compensation deducted in each pay period, up to a maximum of \$25 000 per year, for the purchase of common stock at 85% of the market price.<sup>23</sup>

Options outstanding as a proportion of common stock outstanding reached 40% in the year prior to Cisco's IPO. After the IPO, this figure declined to 7.4% in 1994, but subsequently increased to 16.5% in July 2002 (see Figure 4). The proportion of options granted to stock outstanding in any given year reached a high of 6.3% in fiscal 1997 and



**Figure 4** Cisco System's options outstanding, granted and exercised per year as percentage of total stock outstanding, 1990–2002.

Sources: *Cisco Systems 10-K filings*.

<sup>23</sup>At the end of fiscal 1997, 95% of Cisco's regular employees were eligible for the Purchase Plan. *Cisco Systems 1997 Proxy Statement*.

since then has averaged 3.9%. From 1993 through 2000 options exercised per year averaged 2.6%, ranging from 2.2% in 1995 to 2.7% in 1999. With Cisco's share price having fallen sharply from its peak in March 2000 (see Figure 3), options exercised have dropped distinctly, accounting for only 1.8% of outstanding shares in 2001 and 0.7% in 2002.

In 1998 John Chambers was reported to have said that 40% of Cisco's stock options were in the hands of individuals without managerial rank, and was quoted as saying: 'The average employee who's been with us for more than a year has \$125 000 profit on un-exercised options . . . That's on top of an average starting salary of about \$70 000 per year' (Chetham, 1998: 12).<sup>24</sup> The most detailed public information on the distribution of stock options among its employees that the company has issued is for the three fiscal years ending July 26, 1992 (see Table 5), and thus covers the period for about six months prior to and two and a half years after the company's IPO.<sup>25</sup> Over this three-year period, the top 11 executives received 27.6% of all options granted, and all of the other Cisco

**Table 5** Cisco Systems, distribution of options granted and exercised, August 1989–July 1992 (Cisco's closing stock price on July 24, 1992 = \$51.75)

	Options granted, number of shares (% of total)	Weighted average exercise price	Options exercised, number of shares (% of total)	Net value realized
Five top executive officers	1 480 000 <sup>a</sup> (19.7%)	\$7.84	1 167 500 (14.0%)	\$22 439 956
Six other executive officers	590 000 (7.9%)	\$35.43	2 449 032 (29.4%)	\$38 375 383
Six non-executive directors	120 000 (1.6%)	\$19.96	164 000 (2.0%)	\$649 500
All other employees	5 319 698 (70.8%)	\$11.94	4 544 734 (54.6%)	not available
Total	7 509 698 (100%)	\$13.11	8 325 266 (100%)	not available

Source: *Cisco System 1992 Proxy Statement*, 14

<sup>a</sup>Includes John Morgridge (30 000 options granted; average exercise price = \$39.2500), John Chambers (700 000; \$10.315), David Ring (20 000; \$39.2500); Douglas Allred (130 000, \$17.0625) and Catherine Muther (600 000; \$0.3333).

<sup>24</sup>In a 1997 article Chambers was quoted as saying that '42 percent of Cisco's stock options are held by rank-and-file employees with an average gain of more than \$100 000' (Himmelstein, 1997: 130). In his book on Cisco, Bunnell (2000: 170) stated that '[a]bout 40 percent of the stock options at the company are held by nonmanagerial employees . . . whose option gains average more than \$150 000'.

<sup>25</sup>As reported below, in subsequent Proxy Statements, Cisco only provided information on the proportion of total stock-option grants going to the CEO and the four other high paid executive officers.

employees (254 at the end of fiscal 1990, 505 at the end of fiscal 1991, and 882 at the end of fiscal 1992) received 70.8%.

With the apparent exception of John Morgridge, starting in the early 1990s, Cisco's top executives reaped fortunes on stock option compensation.<sup>26</sup> In compliance with SEC reporting requirements, in its annual Proxy Statements since 1992 Cisco has provided compensation information for its CEO and four (and in some cases five) other highest paid executive officers (see Table 6). Over the period 1991–1995, Morgridge as CEO was paid an annual average of \$389 000 in total compensation, of which 55% was base salary and the rest was bonus, with no long-term compensation. Over the course of his employment at Cisco from 1991 through fiscal 2002, Chambers received a total of \$375.8 million in remuneration (salary, bonus, and stock-based compensation), of which 98.3% was in the form of the net value of options exercised,

**Table 6** Cisco stock options granted to CEO and other highest paid executives, 1992–2002

Year	CEO			Other highest paid executives			
	% of all stock option grants	Total compensation (tc; \$)	% of tc through stock options	No. of executives	% of all stock option grants	Average total compensation (atc; \$)	% of atc through stock options
1992	0.80 <sup>a</sup>	333 037	0.00	4	10.89 <sup>a</sup>	5 855 235	95.81
1993	1.25	359 304	0.00	4	0.63	6 313 115	95.60
1994	3.14	385 792	0.00	4	2.72	4 904 739	93.87
1995 <sup>b</sup>	0.00	294 799	0.00				
1995 <sup>c</sup>	1.47	4 441 825	95.56	5	3.38	3 883 765	92.00
1996	3.36	33 212 313	98.14	4	1.94	12 068 586	96.03
1997	1.99	558 234	0.00	4	1.53	4 688 160	83.29
1998	2.19	890 517	0.00	4	2.19	8 357 043	89.33
1999	2.36	121 700 129	99.23	4	1.64	25 918 142	96.21
2000	1.33	157 303 609	99.16	5	1.36	31 632 576	96.00
2001	2.01	268 131	0.00	4	0.81	5 248 344	97.42
2002	1.43	1	0.00	4	1.46	2 024 154	49.73

Source: *Cisco Systems Proxy Statements*.

<sup>a</sup>For three years, fiscal 1990, 1991 and 1992.

<sup>b</sup>CEO data for John Morgridge. During fiscal 1995, Morgridge was CEO from August 1, 1994 to January 31, 1995.

<sup>c</sup>CEO data for John Chambers. During fiscal 1995, Chambers became CEO on February 1, 1995. Half of his total compensation for fiscal 1995 is included under CEO total compensation, while the other half is included under 'other highest paid executives' compensation.

<sup>26</sup>See surveys of executive pay in Eckhouse (1992: C2), Byrne (1994: 52) and Louis (1994: B2, 1998: E1).

including a total of \$276.7 million—over 77% of his remuneration over the whole period—from options exercised at the height of the speculative boom in 1999 and 2000. Over the period 1992–2002 stock-option remuneration accounted for over 94% of the remuneration of the non-CEO executive officers (excluding Chambers in 1992–1994) whose compensation Cisco reported.<sup>27</sup>

In recognition of the company's poor financial performance, Cisco's executives did not receive bonuses for fiscal year 2001. In 2000 Chambers had received a bonus of \$1 million, while bonuses for the other four highest paid executives had averaged \$879 240. In 2002 the bonuses for this non-CEO group averaged \$636 111. But it is through stock options, not performance bonuses, that Cisco executives have reaped the lion's share of their rewards. In fiscal 2002 Chambers took a self-imposed pay cut, receiving only one dollar in total compensation for the year, thus lowering his average annual realized remuneration over his eight years as Cisco's CEO by an average of \$5.8 million. He also refused to accept two million option grants that he was awarded at the time when the company distributed options to employees under its broad-based plan.<sup>28</sup> Nevertheless, during 2002 he received four million option grants on top of the six million grants awarded to him in 2001. Even with Cisco's stock price at \$11.82 at the end of Cisco's 2002 fiscal year—down 85% from its March 2000 peak—Chambers still held 35.4 million in-the-money stock options, of which more than two-thirds were exercisable with a net value of \$77.1 million.

In September 2001 Cisco announced that it would grant new stock options in May 2002 to help compensate employees for options that were likely to remain valueless (Pender, 2001). With Cisco's stock price closing at \$13.86 on January 24, 2003 (the most recent available stock option data at the time of writing), however, an estimated 70% of the options held by Cisco employees were 'under water', and employees who had been granted stock options before July 1996 could lay claim to 75–80% of the aggregate

<sup>27</sup>Over the period 1995–2002, Larry Carter, chief financial officer, received \$115.6 million, of which 95.3% was from the exercise of stock options. Carter not only netted \$68.3 million through the exercise of options in 1999–2000 but another \$29.0 million from exercising options with the stock market collapsing in fiscal 2001. On July 27, 2002, Carter held 5.9 million in-the-money options, of which half were exercisable with a net value of \$11.3 million; Mario Mazzola, chief development officer, held 6.8 million in-the-money options, of which more than two-thirds were exercisable with a net value of \$16.1 million; while Volpi, senior vice-president, Routing Technology Group, after realizing a net gain of \$30.4 million from exercising options in fiscal 2001, held 3.6 million options, of which 1.2 million were exercisable but, at the market price of \$11.82, worth only \$198 705 (*Cisco Systems 2002 Proxy Statement*: 20).

<sup>28</sup>The option grants made to Mr. Chambers during the 2002 fiscal year were awarded at the same time the Committee granted stock options to other employees under the Company's broad-based stock option program. In July 2002, Mr. Chambers informed the Committee of his decision to waive all of his rights to the option grant for 2 000 000 shares granted on April 5, 2002, and requested that the Committee cancel that option grant. The Committee honored Mr. Chambers' request, and the option grant has been cancelled and is no longer outstanding' (*Cisco Systems 2002 Proxy Statement*: 18). In April 2003 Cisco granted Chambers two million options (Grant, 2003).

**Table 7** Cisco Systems stock options outstanding, January 25, 2003 (Cisco's closing stock price at January 24, 2003 = \$13.86)

Range of exercise prices (\$)	No. of options outstanding (millions)	Weighted average remaining contractual life (years)	Weighted average exercisable price per share (\$)	Aggregate intrinsic value (\$ millions)
0.01–5.60	128	2.94	4.46	1154
5.61–9.74	148	5.90	8.46	489
9.75–15.48	147	5.40	12.75	173
15.49–16.24	159	7.62	16.05	0
16.25–20.61	179	7.49	19.25	0
20.62–36.71	147	5.40	27.76	0
36.72–51.90	139	6.71	49.10	0
51.91–55.42	144	5.95	54.37	0
55.43–72.56	67	6.35	63.96	0
Totals	1258	6.04	26.08	1816

Source: *Cisco Systems 10-Q*, quarterly period ending January 24, 2003: 22.

intrinsic value (the aggregated spreads between the January 24 closing stock price of \$13.86 and the option exercise prices) of the in-the-money options (see Table 7).

*Cash.* In its February 1990 IPO, Cisco raised \$47.6 million, a sum that was over 170% of its revenues and more than 11 times its earnings in the 1989 fiscal year. Even then, the funds raised through the IPO were not critical to Cisco's cash flow; its funds from operations were more than seven times its capital expenditures in 1989 and more than twice in 1990 (see Table 8). Since then, Cisco has not had to go to the stock market for cash, nor has it ever issued any debt. As is also shown in Table 8, the company has had ample funds from operations on a year-to-year basis to cover its capital expenditures.

An important reason why Cisco has been able to fund itself internally is the fact that, from its inception, the company has outsourced manufacturing. High volume products, such as low-end routers, have been built, tested and shipped by factories owned and operated by other companies. For highly configured products, however, Cisco has outsourced sub-assembly while doing final testing and assembly in-house in a small number of manufacturing facilities (Tempest *et al.*, 1998: 4). In June 2000, at the height of the boom, driven by the greater need to control new product development and product quality in its optical networking business than was the case in its internet equipment business, Cisco made a major investment in a systems-integration facility in Salem, New Hampshire, within a half-hour drive of Lucent's main systems integration plant located in North Andover, Massachusetts. The Cisco plant, which was run by ten

**Table 8** Cisco Systems, sources and uses of funds, 1996–2002<sup>a</sup> (\$ millions)

Year	Funds from operations	Capital expenditures	Long-term debt	Cash dividends	Stock sales or issues	Stock repurchases	Tax benefit from employee stock plan
1988	-0.19	0.25	0	0	0	0	NA <sup>b</sup>
1989	2.18	0.30	0	0	0	0	NA
1990	9.53	4.10	0	0	48 <sup>c</sup>	0	NA
1991	44	11	0	0	2	0	13
1992	126	21	0	0	9	0	24
1993	176	34	0	0	19	0	40
1994	328	70	0	0	25	0	36
1995	443	152	0	0	135	70	59
1996	1063	283	0	0	117	116	198
1997	1442	330	0	0	280	323	274
1998	2865	429	0	0	555	0	422
1999	4325	602	0	0	947	0	837
2000	6141	1086	0	0	1564	0	3077
2001	6392	2271	0	0	1262	0	1755
2002	6587	2641	0	0	655	1854	61

Source: *Cisco Systems Annual Reports*.

<sup>a</sup>Fiscal years ending last week in July.

<sup>b</sup>NA, not available.

<sup>c</sup>Stock issued in IPO; all other cash raised from stock was through sales to employees who exercised stock options.

managers and engineers lured from the nearby Lucent plant, was expected to employ 2500 people by 2002. But the downturn in the industry meant that, as of late 2001, Cisco employed only 150 people at the site, and had leased most of the plant to the contract manufacturer, Celestica (Lazonick *et al.*, 2002).

Although Cisco has not gone to the stock market for cash since its IPO, its use of stock as a compensation currency means that it regularly sells stock to employees for cash when they exercise their stock options. With the exception of the stock issued in the IPO in 1990, all of the other stock that Cisco has sold for cash has been for this purpose. Although the amounts of cash thus raised have often been substantial, these funds have been a technical implication of the company's compensation policy rather than a reflection of its financial policy; the positive cash flow is simply the result of its stock option program. Cisco has not needed this cash secured from employees to fund its investments. It should be noted, moreover, that Cisco can reap a substantial tax

benefit when employees exercise their stock options. Under US tax law, when an employee who has exercised an 'incentive stock option' sells the shares thus acquired on the market within one year (in which case the gain is taxed as ordinary income), the company that granted the stock option gets a full tax credit for the amount of income tax that the employee paid. In 2000 alone, this tax benefit reduced Cisco's tax bill by \$3.1 billion.

Cisco pays no dividends. The use of stock as a compensation and combination currency, however, dilutes shareholding, and other things equal, will tend to depress a company's stock price. To offset such an impact, Cisco has strategically repurchased stock—a practice that has become a New Economy mode of returning value to shareholders without paying dividends. In the speculative boom of 1998–2000 Cisco did not have to do stock repurchases to support its stock price. In September 2001, however, with the stock market depressed, Cisco's board authorized stock repurchases up to \$3 billion, and by the end of fiscal 2002 Cisco had repurchased \$1.9 billion of its stock. With its stock price still falling, in August 2002 the board increased authorized purchases by another \$5 billion (Harvey, 2002c). During the first quarter of 2003, Cisco repurchased another \$1.1 billion of its stock (*Cisco Systems 10-Q, quarter ending October 26, 2002*: 5). These repurchases, involving 232 million shares, represented about 3.2% of Cisco's shares outstanding at the end of fiscal 2001. Through its stock repurchases, Cisco has been, since its 1990 IPO, a source of cash to the stock market rather than the stock market being a source of cash to Cisco.

## 5. The Old Economy's 'creative response'

### 5.1 *From boom to bust*

During the New Economy boom of the last half of the 1990s, Nortel Networks, Lucent Technologies and Alcatel were the three Old Economy telecommunications equipment suppliers that sought to use their stock as a combination and compensation currency to make the transition to the New Economy. In doing so, they were responding to not only the technological and market challenges of a converging communications industry but also the competitive challenge of the 'New Economy business model' that, in making the transition from internetworking to optical networking, Cisco Systems, had brought into their industry.

Indeed, during the boom the stock market treated Nortel, Lucent and Alcatel as if they were New Economy companies. As displayed in Figure 3, taking April 1996 as the base (which was when Lucent was listed on NYSE), stock price increases to their peaks were for Nortel (peaking in July 2000), 1257%; Lucent (December 1999), 839%; and Alcatel (August 2000), 366%. By comparison, the increase for Cisco (peaking in March 2000) was 1307%, and for DJIA (January 2000), 108%; S&P500 (March 2000), 136%; and NASDAQ (March 2000), 331% (see Figure 2).

In 2001 and 2002, with the collapse of the stock markets, Nortel, Lucent and Alcatel have found themselves in severe difficulty—much more so than Cisco—with revenues

and net income falling sharply from 2000 to 2002 (see Table 9). Compared with the other firms studied, Alcatel's revenues were relatively less concentrated in the US market, where the downturn originated in 2000 and was initially most severe. As the slowdown spread to Europe, however, Alcatel's revenues declined, and for 2001 the company recorded a loss of \$4.4 billion, the largest in French corporate history at the time. Cisco owes its superior performance in 2001 and 2002 partly to the fact that it was much less reliant on service providers as customers; during 2001–2002 the demand for equipment by enterprises remained much stronger than by carriers.

As shown in Figure 5, starting from an A1 bond rating in July 2001, Moody's downgraded Alcatel five times, with the B1 rating as of November 2002 signifying that the company's senior debt obligations 'generally lack characteristics of desirable investment.' Nevertheless, the devastation was worse at Nortel and Lucent. Between July 2000 and November 2002, Moody's downgraded Nortel's bond rating six times, with the company's senior debt descending to 'junk' status—Ba3 or below—on April 4, 2002 before falling further to B3 by the end of the year. The rating of Lucent's senior debt began its descent earlier (December 2000), and fell further than the other two companies, reaching 'junk' status in August 2001, and after six downgrades declining to Caa1 in November 2002. Moody's gives a Caa rating to 'bonds . . . of poor standing [that] may be in default or [for which] there may be present elements of danger with respect to principal or interest' (see [www.moodys.com](http://www.moodys.com)).

Table 10 shows the dramatic changes in employment that took place at Nortel,

**Table 9** Revenues<sup>a</sup> and net income<sup>b</sup> of Nortel, Lucent, Alcatel and Cisco in calendar years<sup>c</sup> 2000–2002 (\$ millions)

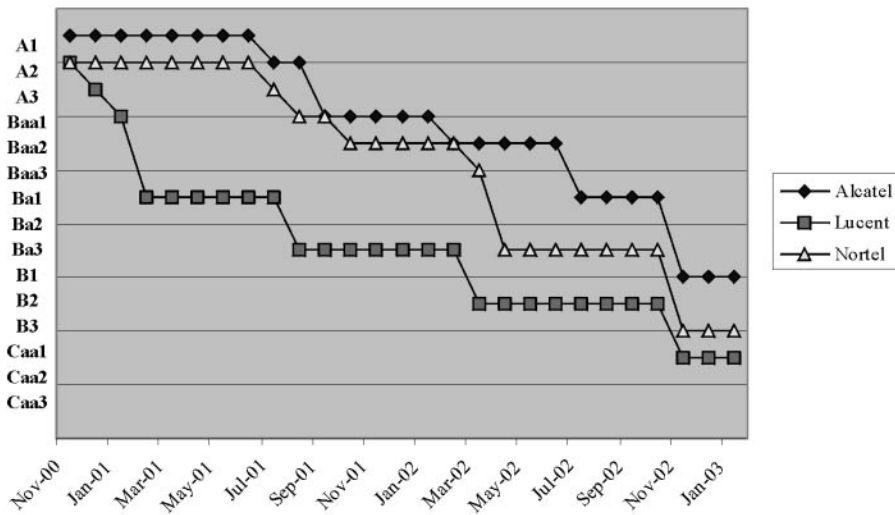
Company	Revenues				Net income		
	2000	2001	2002	% change, 2000–2002	2000	2001	2002
Nortel	30 275	17 511	10 560	–65.1	–3470	–27 302	–3585
Lucent	29 163	20 519	10 817	–62.9	–425	–16 226	–8883
Alcatel	29 580	22 597	17 350	–41.3	1247	–4424	–4975
Cisco	23 123	22 994	19 501	–15.7	2707	–2223	2739

Sources: [www.hoovers.com](http://www.hoovers.com); company SEC filings and press releases.

<sup>a</sup>Equals total sales from operations.

<sup>b</sup>Equals total net income after accounting for all corporate actions.

<sup>c</sup>The end of fiscal year is December 31 for Alcatel and Nortel, September 30 for Lucent, and last week in July for Cisco. To derive calendar-year data for Lucent and Cisco we have adjusted their reported quarterly data.



**Figure 5** Moody’s bond ratings for Alcatel, Lucent and Nortel, November 2000–January 2003. Note: Moody’s describes ‘A’-rated obligations as ‘upper-medium grade’, ‘Baa’ as ‘medium grade with certain speculative characteristics’, ‘Ba’ as ‘more speculative’; and ‘B’ as ‘generally lacking characteristics of the desirable investment’. Obligations rated ‘Ba3’ and below are considered to have junk bond status. The numbers ‘1, 2 and 3’ are modifiers within these categories.

Lucent and Alcatel in the decline. In two years since 2000, Nortel reduced its labor force by 61%, Lucent by 63%, and Alcatel by 41%. To some extent these changes in employment represent an adjustment to ‘normal’ levels of employment after each of the three companies increased the size of its labor force substantially in the boom—Nortel from 1997 to 2000, Lucent from 1996 to 1999 and Alcatel from 1999 to 2000.

The year-to-year changes in employment in Table 10 are, of course, net figures that may reflect both the hiring of new employees and the termination of existing ones. Some of the biggest employment changes at these companies over the period 1996–2002, moreover, had to do with spinning off divisions as separate companies and outsourcing manufacturing rather than layoffs. Let us, therefore, briefly summarize the main elements of these employment changes for Nortel, Lucent and Alcatel.<sup>29</sup>

Over the three years 1997–1999 Nortel terminated 7000 existing employees as it exited old technologies, while, depending on the level of retention, it may have employed as many as 10 000 people who came to the company through its acquisitions. In addition, it would appear that Nortel hired some 6000 people ‘off the street’ in 1999. During 2000 Nortel’s hiring spree accelerated dramatically. The net increase of employment of 16 200 people, included terminations of employment of about 9000 people through divestitures that included the sale of seven manufacturing plants

<sup>29</sup>Unless otherwise indicated, these summaries of employment changes are drawn from information contained in the companies’ annual reports and SEC filings.

**Table 10** Employees of Nortel, Lucent, Alcatel and Cisco, 1996–2002 (and announced targets, end of fiscal 2003)

No. of employees, end of fiscal year <sup>a</sup>	Nortel	Lucent	Alcatel	Cisco
1996	68 000	124 000	190 600	8782
1997	68 300	134 000	189 549	11 000
1998	71 300	141 600	118 272	15 000
1999	76 700	153 000	115 712	21 000
2000	92 900	126 000	131 598	34 000
2001	52 600	77 000	99 314	38 000
2002	36 960	47 000	75 940	36 000
2003 <sup>b</sup>	36 000	35 000	60 000	no target

Sources: [www.hoovers.com](http://www.hoovers.com); *Company 10K* filings; *Nortel Networks 2002 Third Quarter Shareholders Report*: 8; *Alcatel Annual Reports*; *Alcatel's Strategy for 2003* ([www.alcatel.com](http://www.alcatel.com)); *Dallas Morning News*, February 5, 2003.

<sup>a</sup>Nortel, December 31; Lucent, September 30; Alcatel, December 31; Cisco, last week in July.

<sup>b</sup>Announced targets (made by Nortel, Lucent and Alcatel) for end of calendar-year 2003.

employing 4200 people to the contract manufacturer, Solectron, as part of a four-year, \$10 billion contract (the largest manufacturing supply agreement on record at the time) to supply Nortel with components and modules. The implication is that Nortel hired as many as 25 000 new employees in 2000, among whom up to 1565 were employees of the nine companies that Nortel acquired in that year. During 2000 Nortel increased the number of people it employed in Europe by over 8150, bringing the total employed there to over 25% of its worldwide labor force, up from 20% a year earlier. The company also increased its worldwide employment of R&D personnel by 4000, an 18% rise from 1999.

The downsizing of Nortel in 2001 was, however, even more dramatic than its expansion a year earlier as it cut employment by over 40 000 people, the vast majority of whom were terminated through layoffs and outsourcing. During 2002 Nortel reduced employment by another 15 640 people. The outsourcing strategy continued, with the number of manufacturing sites being reduced from 29 at the end of 2000 to 11 at the end of 2002, thus helping to drive down the proportion of Nortel's labor force that was unionized to 5% in 2002 (less than 1900 people) from 7% in 2000 (6500 people); it had been 12% (8200 people) in 1997. In the decline, however, high-end work was hit as well. Within two years from the end of 2000, Nortel's R&D staff was cut almost in half, from 26 500 to 13 720, although the proportion of R&D personnel of total employees increased from under 29% in 2000 to over 37% in 2002. In August 2002 Nortel

announced plans for further layoffs and plant closures that, when completed, would bring its labor force down to 35 000 (subsequently amended to 36 000).

Lucent Technologies was spun off from AT&T in April 1996 with 131 000 employees and a restructuring plan to eliminate 23 000 existing jobs. By September 30, 1998 Lucent reported that it had shed 19 900 jobs, most of them in the first year.<sup>30</sup> In part, this restructuring took the form of a rationalization of the company's worldwide manufacturing capacity; between 1996 and 1998 Lucent reduced its number of plants from 58 to 30. Nevertheless, by the end of September 1998 Lucent had increased its employment to 141 600, implying that the company had added some 30 000 new employees in the previous two years. During 1999 Lucent's net addition to employment was 11 400 people, with no significant layoffs. Of the 40 000–45 000 new employees that Lucent recruited worldwide between September 1996 and September 1999, at most 13 500 came from acquisitions. During 2000 Lucent hired perhaps 10 000 new employees (the exact number depending on how many existing employees left the company during this year of high labor mobility), of whom up to 1400 employees came through acquisitions. During 2000 Lucent also spun off its 30 000-person enterprise networks business as Avaya, thus contributing significantly to the reduction of its employment to 126 000 by the end of that year.

In 2001, with revenues declining sharply from their 1999 peak, Lucent commenced a major restructuring program. By September 2002 Lucent had reduced its employment by 79 000 people, or 63% of its labor force two years before. Most of these terminations were layoffs, including an early retirement program offered to 8500 management personnel. Three divestitures—its power business sold to Tyco, fiber optic cable business sold to Furukawa, and microelectronics business spun off as Agere—removed almost 28 000 people from the company. In addition, as a continuation of an outsourcing strategy begun in the boom but one that became driven by need to downsize in the decline, Lucent sold or leased some of its major manufacturing plants to contract manufacturers such as Solectron and Celestica (for a detailed case study, see Lazonick *et al.*, 2002). In the process, what had been a highly unionized labor force was decimated; in September 1999 Lucent had 46 818 union employees, in September 2002 only 6800. In October 2002 Lucent reported its 10th consecutive quarterly loss and announced that it expected that it would have to reduce its labor force to 35 000 at the end of 2003 in order to break even.

Virtually all of Alcatel's massive decrease in employment during 1998 was the combined result of the sale of its non-telecommunications engineering and systems business to GEC Alsthom (its joint-venture power business with the British company, GEC), and the subsequent spinoff of GEC Alsthom as an independent company, Alstom. Without these changes, Alcatel would have had little if any change in net employment during 1998; while it terminated 5577 employees, the total number of

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<sup>30</sup>The Lucent fiscal year runs from October 1 of the previous calendar year through the following September 30. Unless otherwise stated, all references to particular years in this account of Lucent's restructuring are to fiscal years.

employees at the companies it acquired was 6931. Nor did Alcatel do much new hiring 'off the street' the following year; with net employment down by 2560, there were 7842 terminations as part of ongoing restructuring activities and 1966 people at the companies it acquired. Alcatel's major increase in employment came in 2000. Given 4177 terminations in that year, Alcatel appears to have hired 20 000 new people, among whom as many as 6500 may have joined from acquisitions. As a result of these changes, the proportion of Alcatel's labor force that had at least three years of higher education increased from 30% at the end of 1996 to 46% at the end of 2000.

In the decline of 2000–2002 Alcatel reduced net employment by 55 568 people, of whom 18 186 were separated from the company in 2001 when it spun off its cables business as Nexans. Alcatel also undertook a vigorous outsourcing strategy. In an interview in June 2001, CEO Serge Tchuruk said that he aimed to cut back the number of Alcatel's manufacturing plants from 120 to a dozen or fewer by the end of 2002, claiming that 'we're going to be a fab-less company pretty soon' (Delaney, 2001). In 2001 and the first half of 2002, a number of plants were sold or leased to Flextronics, Jabil Circuit and Sanmina-SCI. With terminations of 13 867 and at most 657 people joining from acquisitions, this outsourcing activity may have involved the transfer of as many as 24 000 employees off Alcatel's payroll. In September 2002 Alcatel announced another round of layoffs, stating that it expected to reduce its labor force to 60 000 by the end of 2003. As a result of these changes in the decline, the proportion of Alcatel's labor force that had at least three years of higher education increased from 46% at the end of 2000 to 53% at the end of 2002.

The immediate cause of the problems of the Old Economy companies has been the sharp downturn in demand for telecommunications equipment, which in turn was the result of a frenetic overbuilding of new capacity by telecommunications service providers including incumbents (such as AT&T and France Telecom), entrants (such as Global Crossing and Level 3) and entrant/acquirers (such as WorldCom and Qwest). As of October 2002, 67 major telecommunications service providers had gone bankrupt.<sup>31</sup> While recognizing that the slump in demand in their major markets is beyond the control of the companies concerned, we shall present suggestive (although by no means definitive) evidence that in their efforts to use stock as a currency to accumulate innovative capability during the boom the managements of Nortel and Lucent made decisions and took actions that made them more vulnerable to the depressed market conditions of 2001 and 2002.

First, however, we document the changing functions of the stock market in the boom period 1998–2000 at Nortel, Lucent and Alcatel, as these companies sought to adopt the New Economy business model. Then, in Section 6, we assess the impacts of the ways in which these companies sought to make this transition—and in particular on their

<sup>31</sup>These included 25 long-haul and fiber network wholesalers (among which were Enron Broadband, Global Crossing, WorldCom, KPNQwest, 360Networks and Williams Communications), 25 CLEC/DLEC and cable companies, 10 wireless/satellite providers and seven internet service providers ([www.convergedigest.com](http://www.convergedigest.com)).

reliance on their stock as a combination and compensation currency—on the character and extent of their current problems.

### 5.2 *The functions of the stock market*

*Control.*<sup>32</sup> At Nortel, Lucent and Alcatel, ownership has long been separated from control. Nortel Networks was originally established in 1895 as Northern Electric and Manufacturing Ltd., the equipment subsidiary of the Canadian public carrier, Bell Canada. When, after a merger with Imperial Wire and Cable Company, the company was renamed Northern Electric Company Limited, Bell Canada owned 50% of its shares while AT&T's equipment subsidiary, Western Electric, owned 44%. Western Electric remained a minority shareholder of Northern Electric until 1962, after which the company became a wholly owned subsidiary of Bell Canada until it went public in 1972. Even then, Bell Canada still held 90% of Northern Electric's shares, and continued to buy all its switching systems from the company. In 1976 Northern Electric became Northern Telecom, whose name was in turn officially shortened to Nortel on the occasion of the company's 100th anniversary in 1995. When Nortel acquired Bay Networks in 1998, it changed its name to Nortel Networks. In 2000, Bell Canada, still owning 37% of Nortel's shares, transferred 94% of its holdings to a new entity, Nortel Networks Technologies, whose stock was distributed to Bell Canada shareholders (MacDonald, 2000).

During the boom, Nortel's CEO was John A. Roth, who was promoted to that position from chief operating officer (COO) in October 1997. Roth, who was 54 when he became CEO, had joined the company as a design engineer in 1969, had become president of its R&D arm in 1982, and then had started the company's wireless business in 1991.<sup>33</sup> In November 2001, with the company in trouble, Frank A. Dunn replaced Roth as CEO. Then 48, Dunn had joined the company in 1976, with a Bachelor of Commerce degree, and had worked his way up through various management positions to become chief financial officer in January 2000.

Lucent Technologies was spun off from AT&T in 1996. But the company had a long history, dating back to its foundation in 1872 as the Western Electric Manufacturing Company. In 1881, American Bell, the predecessor of AT&T, secured a controlling interest of Western Electric as its exclusive manufacturer of telephones in the USA (Stehman, 1925; <http://www.lucent.com/corpinfo/history.html>). From the outset salaried managers, not shareholders, ran Bell. The most important manager was Theodore Vail, whom the founders recruited as the company's top executive when it was launched in 1878. Vail directed the growth of the Bell System for the next decade before quitting the position, only to return again, first as a board member of AT&T in 1900,

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<sup>32</sup>Unless otherwise indicated, the information in this section is taken from company websites and press releases.

<sup>33</sup>John Roth to succeed Jean Monty as CEO of Nortel (Northern Telecom) in October 1997,' *Canada NewsWire*, February 27, 1997.

and then as CEO of the company from 1907 to 1919 (Galambos, 1992). When Vail re-entered the company, it was subject to intense competition, the Bell patents having expired in 1894. Vail's most lasting achievement was to transform the company into a regulated monopoly, with Bell Labs devoted to state-of-the-art R&D and the company as a whole committed to delivering telephone service to every locality in the USA, no matter how isolated it may have been. It was only in 1985, as a result of a US antitrust decree, that the monopoly came to an end. The 'breakup' of AT&T separated the operating companies from AT&T as the long-distance carrier, and also transformed the wholly owned manufacturing subsidiary, Western Electric, into AT&T Technologies, an internal division of AT&T. In 1996 AT&T spun off AT&T Technologies into the independent company, Lucent Technologies, which incorporated within it Bell Labs.

Henry B. Schacht, then 61, became Lucent's first chairman and CEO. From 1973 to 1994, Schacht had been CEO of Cummins Engine Company, and had also been a member of the AT&T board of directors from 1981 to 1996. After leaving Cummins (where he remained as chairman to 1995), Schacht had officially retired as a corporate executive, but agreed to take the top position at Lucent to lead its transition as a corporate entity separate from AT&T. Second in command as president and COO was Richard A. McGinn, 49, who had started out with Illinois Bell in 1969 before joining AT&T in 1978, and who had been head of AT&T's Network Systems division since 1993. In October 1997 McGinn took over as CEO, and the following February also as chairman. At that time, Schacht became chairman of Lucent Venture Partners, an independent \$100 million venture capital fund that Lucent set up.<sup>34</sup> In March 2000, as an attempt to boost its already sagging stock price, Lucent announced that it would spin off its low-yielding PBX, business cabling and LAN-based businesses into an independent entity, eventually named Avaya, and that Schacht would become its chairman. By October 2000, however, it was becoming clear that Lucent as a whole was in serious trouble. McGinn was ousted from Lucent, and, as his replacement, Schacht was once again named chairman and CEO. It was understood that Schacht, now 66, would look for a successor, and in January 2002, Patricia F. Russo, aged 50, was named president and CEO of Lucent, with Schacht staying on as chairman. Russo had worked in sales and marketing at IBM for eight years before joining Lucent in 1981. From 1992 to 2000 she held high-level executive positions at AT&T and Lucent. In August 2000, she left Lucent, but when Schacht took over from McGinn as head of the company, Russo was appointed chairman of Avaya. The following April she joined Eastman Kodak as president and COO, but nine months later she was recruited back to head Lucent. In February 2003 Schacht stepped down as chairman, with Russo adding that title.

Alcatel was originally part of France's *Compagnie Générale d'Electricité* (CGE), the name given to the company in 1898 when the *Société Normande d'Electricité* (SNE)

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<sup>34</sup>Lucent Venture Partners was distinct from Lucent Ventures Group that sought to commercialize Bell Labs technology.

was floated in order to facilitate its expansion beyond the area of Normandy and into new activities (Alcatel, 1992). The key executive in the transformation of SNE into CGE was Pierre Azaria, an Egyptian-born engineer educated in France who then remained president of CGE until 1937. A salaried manager at SNE, at no point in the history of CGE did Azaria become a significant shareholder. In 1982 CGE was one of a number of French companies that was nationalized by the socialist government of newly elected French president, François Mitterrand. Renamed simply Alcatel in 1985, the subsidiary of CGE was the fifth largest telecommunications equipment supplier in the world. The company was still viewed, however, as overly 'French', with less than 5% of its turnover in the USA, compared with, for example, Siemens' 9%. To establish itself as a more global player, Alcatel paid \$577 million to take a 55.6% share of a joint venture with ITT that gave it control over ITT's European operations (Betts, 1987a). Overnight, CGE's Alcatel moved to second position in the global telecom equipment market, after AT&T. On December 30, 1986 Alcatel NV was set up as the holding company for the telecommunications, enterprise communications and fiber-optics businesses of ITT, with 21.0% of its shares being held by CGE, 34.1% by a financial subsidiary of Alcatel SA, 3.7% by Société Générale de Belgique and 1.7% by Crédit Lyonnais. From this era, Alcatel adopted English as its official language (Dodsworth, 1988).

In light of its strong financial performance throughout the 1980s, CGE was one of the first French firms to be 'denationalized' in a complex three-part operation between May 11 and 23, 1987. Nationalized in 1982 at a cost of FF3.5 billion, the group's capitalization at the time of its IPO amounted to FF20.6 billion. This sum included FF6.3 billion in fresh equity funds to the company, the largest fund-raising exercise by a company on the French stock exchange up to that time, and one that helped the company pay down the debt taken on in the ITT acquisition. Ten percent of the shares were offered to the firm's employees, 20% to international investors and 70% to French investors (Betts, 1987b). For the first time in the CGE's history, US institutional investors became shareholders.

As was generally the case in French privatizations, a stable core of shareholders, or *noyau dur*, emerged. The state dissolved the Société Française de Partenariat Industriel (SFPI), which owned a quarter of CGE, and divided its capital among the state and three large publicly-owned banks: BNP, Crédit Lyonnais and Société Générale, which ended up with a combined ownership stake of 12.8%. CGE's subsidiaries owned 6.8% of their parent company and the employees' investment fund 3.4%. The privatization of CGE meant that 2 240 000 French citizens became shareholders, 20 times the number that existed before the operation.

In 1991 CGE changed its name to Alcatel-Alsthom, with Alcatel continuing as its telecommunications subsidiary. The current chairman and CEO of Alcatel, Serge Tchuruk, headed the French oil company, Total, for five years before coming to lead Alcatel-Alsthom in 1995 at the age of 57. Tchuruk replaced Pierre Suard (see Suard, 2002). and proceeded to divest the company's businesses that were unrelated to telecommunications. In 1998, as a result of this restructuring process (which included

the initial public offering of the company's power-generation subsidiary as Alstom), Alcatel-Alsthom was renamed Alcatel, and positioned itself as a major global player in optical networking. As of 2003, Tchuruk remains Alcatel's CEO.

During the New Economy boom, a key senior executive was Krish Prabhu, an electrical engineer who, at the age of 36 after working at Bell Labs and Rockwell International, had joined Alcatel in 1991, when Alcatel bought Rockwell's network transmission division. In 1996 Prabhu became president of Alcatel's broadband division, and the following year became a member of Alcatel's Executive Committee and CEO of the company's US subsidiary, Alcatel Network Systems (renamed Alcatel USA in 1998). As the main architect of Alcatel's US acquisition strategy, in 1999 Prabhu became COO of Alcatel while remaining the CEO of Alcatel USA. In May 2001, when Alcatel and Lucent were negotiating their prospective (and ultimately aborted) merger, Prabhu was expected to become the CEO of the US operations of the combined company, and indeed was often mentioned in the press as the eventual successor to Tchuruk as Alcatel's CEO (Daniel *et al.*, 2001). In July 2001, however, on the same day that Alcatel posted a second quarter loss of \$2.7 billion, Prabhu announced his resignation from Alcatel for personal reasons.<sup>35</sup> Although Alcatel announced that Prabhu would remain a member of the board of directors, by January 2002 he had resigned this position and severed his connection with the company (*Alcatel 1999 Annual Report*, 10).

Ownership remains separated from control at Nortel, Lucent and Alcatel. On February 28, 2002, Roth held 0.17% of common shares outstanding, and Dunn, now CEO, held 0.01%, while 35 directors, nominees and officers of the company as a group held 0.38% (*Nortel Networks 2002 Proxy Statements*: 6). As of October 1, 2002, four Lucent executives—Schacht, Russo, Robert Holder (COO) and William O'Shea (president of Bell Labs)—each held between 0.15 and 0.19% of Lucent's outstanding common shares, with nine other directors and executives holding as a group an additional 0.16% (*Lucent Technologies 2002 Proxy Statement*: 16). As of March 1, 2003, Serge Tchuruk held less than 0.01% of Alcatel's outstanding 'A' shares and a negligible amount of the companies outstanding 'O' shares, while Daniel Bernard, the largest shareholder on Alcatel's board of directors, held just over 0.01% of the outstanding number of each type of share (*Alcatel 2002 20-F*: 74).<sup>36</sup>

The outside ownership of these firms is also widely dispersed (see Table 11). Institutional investors are bigger shareholders in the North American corporations than in Alcatel (see Table 11). As of September 30, 2002, Brandes Investments was the largest single shareholder at Nortel, Lucent and Alcatel, and held a particularly large stake in the Canadian company.

At Nortel, Lucent and Alcatel, therefore, the listing of the company on the stock

<sup>35</sup>'Key executive leaves Alcatel's US operations,' *Business News*, July 27.

<sup>36</sup>'A' shares represent Alcatel stock, whereas 'O' shares represent a 'tracking stock' in Alcatel Optronics, set up in September 2000 and abolished in April 2003.

**Table 11** Shareholdings, Nortel, Lucent, Alcatel and Cisco, 2002<sup>a</sup>

Company	No. of registered shareholders <sup>b</sup>	% of shares held by top ten financial institutions	% of shares held by top ten mutual and pension funds	Largest institutional investor (% of shares held)
Nortel	206 400	31.62	5.00	Brandes Investments (9.48%)
Lucent	1 504 156	19.89	5.85	Brandes Investments (3.88%)
Alcatel	480 000	5.72	0.43	Brandes Investments (4.73%)
Cisco	81 058	19.72	13.79	Barclays Bank plc (3.58%)

<sup>a</sup>Amounts held are as of September 30, 2002 for financial institutions, and generally between May and September 2002 for mutual and pension funds. Company shares outstanding are as of February 2003.

<sup>b</sup>Number of registered shareholders as of, for Nortel, February 28, 2003; for Lucent, October 1, 2002; for Alcatel, December 31, 2001; for Cisco, July 27, 2002.

Sources: finance.yahoo.com; *Nortel 2002 10-K*: 26; *Lucent Technologies 2002 Annual Report*: 53; *Alcatel 2001 Annual Report*: 127; *Cisco Systems 2002 Annual Report*: 50.

market has permitted the widespread distribution of share ownership, thus leaving salaried executives—themselves holding only fractional ownership stakes—in effective control over resource allocation decisions. As we shall discuss below, the stock market is also important to these top executives in its compensation function because of the increasingly important role of stock-based compensation as a component of their earnings. The amount of wealth that their stock-based compensation can generate for these select individuals means that, like Cisco's executives, they have potentially powerful personal incentives to increase the value of their companies' shares.

*Combination.* Coming into the New Economy boom, the technological challenge for the Old Economy incumbents was to produce communications equipment and systems that could integrate data processing capabilities, using packet-switched networks, with voice transmission, most of which initially would be circuit-switched over dedicated lines. The market challenge for the Old Economy companies was to move from supplying carrier networks—their traditional domain—to also supplying enterprise networks, a market in which, as we have seen, Cisco has dominated. In terms of Figure 1, the Old Economy companies were coming from the lower right-hand corner of the industry matrix and striving to move to the upper left-hand corner; they were

structured to provide equipment for the transport core in voice, but they wanted to become players providing data communications closer to the services edge.

As had been the case in Cisco's 1996 acquisition of StrataCom, but coming from the transport layer rather than the service layer, the most critical acquisitions for all three Old Economy companies were of established manufacturers of asynchronous transfer mode (ATM) data-communications equipment for carrier systems. In August 1998 Nortel was the first of the three to make such an acquisition, purchasing for \$9.1 billion in stock—about 26% of Nortel's common shares outstanding at the time (*Nortel Networks 1999 Annual Report*: 55, 85)—BayNetworks, a 7000-person company that was itself a previous merger of Massachusetts-based Wellfleet with California-based SynOptics. In the aftermath of this acquisition the stock market sharply downgraded the price of Nortel's shares; before it announced the acquisition on June 12, 1998, its stock price had been at \$63.69, but fell as low as \$28.06 on October 8, 1998, after the completion of the acquisition. It was only thereafter, with the word 'Networks' officially added to its name at the beginning of October, that Nortel was able to convince the market of its potential for growth in the New Economy. In June 1999 Lucent became a data-networking company by acquiring Ascend for \$24 billion in stock, primarily to gain control of Cascade, a company that Ascend itself had acquired for \$3.7 billion in stock in 1997. In 2000 Alcatel joined the attempt to integrate capabilities in optical networking and data communications by doing a \$7.1 billion stock acquisition of Ottawa-based Newbridge Networks, a company with which Siemens had previously built a strategic alliance (see Meissner and Naschold, 2000).<sup>37</sup>

The fact that Alcatel was listed on NYSE, using American Depository Shares (ADSs)—an equity-based security that permits a foreign-based company's shares to be traded in US dollars—made its stock more attractive to the shareholders of the North American companies that it acquired. Alcatel is the only incumbent optical networking company outside of North America that in the New Economy boom of 1998–2000 was able to use its stock as a currency to acquire companies and compensate non-executive employees on a significant scale. For example, unable to use its stock as an acquisition currency, in 1999 Marconi (then still called GEC) expended more than \$6 billion in cash for two US data communications companies (Fore and RELTEC) (Mayo, 2002).<sup>38</sup>

As shown in Table 12, from 1998 through 2000 the total disclosed market value of

<sup>37</sup>Alcatel had begun to develop ATM capabilities in collaboration with France Telecom in the early 1990s (Crockett, 1991; Wallace, 1993). In 1995, however, when France Telecom rolled out a pilot ATM network to provide broadband services to enterprises, it had chosen Newbridge Networks as its equipment supplier. See 'Newbridge Networks chosen by France Telecom for national ATM network,' *Canada Newswire*, August 9, 1995; also interview by two of the authors of James Watt, senior executive in Alcatel Network Strategy Group, formerly of Newbridge Networks, September 18, 2002.

<sup>38</sup>In describing the 'rise and fall' of Marconi, the ex-chief executive designate, John Mayo (2002) has written that 'what is not widely realised is that the US acquisitions had to be made for cash as GEC was not compliant with the US Foreign Corrupt Practices Act and so could not list in the US'. The Foreign Corrupt Practices Act makes it unlawful to bribe foreign government officials to obtain or retain business. In March 2000, however, Marconi was able to list on NASDAQ.

**Table 12** Market value of acquisitions, acquisition share and mode of payment, Nortel, Lucent, Alcatel and Cisco, 1997–2000

	Nortel (NT)	Lucent (LU)	Alcatel (ALA)	NT + LU + ALA	Cisco (CSCO)	NT + LU + ALA + CSCO
Value of acquisitions (\$m)						
1997	430	2635	0	3065	586	3691
1998	8390	2416	5000	15 806	1114	16 920
1999	6452	32 003	4124	42 579	14 435	57 014
2000	14 395	9996	7233	31 624	12 254	43 878
1998–2000	29 237	44 414	16 358	90 008	27 803	117 811
Percent of total acquisitions by value						
1997	11.8	72.2	0.0	83.9	16.1	100.0
1998	49.6	14.3	29.6	93.4	6.6	100.0
1999	11.3	56.1	7.2	74.7	25.3	100.0
2000	32.8	22.8	16.5	72.1	27.9	100.0
1998–2000	24.8	37.7	13.9	76.4	23.6	100.0
Percent of value acquired with stock						
1997	63.7	30.7	0.0	35.4	70.9	41.1
1998	98.2	38.0	93.7	87.6	84.9	87.4
1999	88.0	99.2	43.0	93.6	99.8	95.1
2000	99.8	97.6	97.6	98.6	98.8	98.7
1998–2000	96.8	95.6	82.6	93.6	98.8	94.8

Sources: Compiled from company annual reports and press releases. Wherever possible, the value of the deal at closing rather than at announcement has been used.

Under accounting rules governing spinoffs, Lucent was not allowed to use pooling-of-interests accounting until October 1998, which reduced its incentive to use stock as the acquisition currency prior to that time. Lucent's acquisition costs not disclosed (employees in parentheses): 1997, Triple C Call Center (18); 1998, Pario Software (4), TKM Communications (45); 1999, Soundlogic CTI (22), CCOM Information Systems (10), Zetax Tecnologica SA (200), Batik Equipamentos SA (400). Lucent's 1998 figures include the acquisition of Stratus by Ascend (\$917 million in stock, 65 employees), and 1999 figures include the acquisition of XNT Systems and Quantum Telecom Solutions by Excel Switching. Cisco's acquisition cost of Telesend (10 employees) in 1997 not disclosed.

acquisitions by Nortel, Lucent, Alcatel and Cisco was \$117.8 billion, of which Old Economy companies dispensed over 76%. The mode of payment for 94.8% of this \$117.8 billion was the acquiring company's stock. During 1998–2000, Cisco made 50 acquisitions, involving about 5100 employees, with 43 acquisitions having 200 or fewer employees; Nortel, 17 acquisitions with 12 300 employees, with nine acquisitions having 200 or fewer employees; Lucent, 32 acquisitions with 11 300 employees, with 18

acquisitions having 200 or fewer employees; and Alcatel eight acquisitions with 15 400 employees, with two acquisitions having 200 or fewer employees.<sup>39</sup> The prices paid for these acquisitions during 1998–2000 were highly inflated compared with previous periods. Indeed, as indicated by Cisco's \$6.9 billion acquisition of Cerent in 1999, at the peak of the boom, in the quest to gain control of the latest technologies, start-ups with little if any revenues were being acquired for billions of dollars in stock. Two dramatic examples, both completed in June 2000, were Nortel's acquisition of  $\chi$ ros, a 90-person optical switch start-up, for \$3.2 billion, and Lucent's acquisition of Chromatis Networks, a 170-person metropolitan area network (MAN) switch start-up, for \$4.5 billion (Bunnell, 2000: 35, 60; Paulson, 2001: 291–294; Carpenter and Lazonick, 2002). The \$36 million that Nortel paid per person to acquire  $\chi$ ros was 50% more than the per-person cost of Cisco's acquisition of Cerent.

*Compensation.* Nortel has had stock option plans for executives dating to 1986, but it took the 1998 acquisition of Bay Networks, with its 7000 employees, to bring non-executive stock options to Nortel. Of the total number of stock options granted by Nortel in 1998, 63% were assumed when the company acquired Bay Networks. Not including options assumed in acquisitions, in 1999 Nortel increased options granted by 72% over the previous year. While the proportion of options assumed in acquisitions to all options granted was less than 2% in 1999, it climbed to 36% in 2000, with the assumed options accounting for 80% of the increase in all options granted in that year (*Nortel Networks August 7 2000* 8-K: F-42; *Nortel Networks May 13 2002* 8-K: 36; *Nortel Networks January 23 2003* 8-K: F-34, F-51). In February 1999, Nortel's board increased the maximum number of shares available under the grant program from 10.2% to 16.2% of all common shares outstanding.

On February 12, 2001, Nortel's chief technology officer, William Hawe, who had come to the company with the Bay Networks acquisition, resigned shortly after exercising options on over 600 000 shares, which he sold for \$18.4 million. This sale occurred three days before Nortel released an earnings report that cut its growth expectations in half (MacGregor, 2001). On June 20, 2001, with all of the options granted from February 1999 under water, Nortel introduced a program that allowed employees to exchange certain options outstanding for new ones, based on a prescribed formula (*Nortel Networks 2002* 10-K: 36). This manoeuvre in effect repriced Nortel's stock options at \$8.01, a level that the stock has not attained since January 2002. No options were exercised in 2002, and during the first three months of 2003, Nortel's stock price did not rise above \$2.72.

In 2000 CEO Roth's total earnings were just over \$100 million, of which 91% was from exercising stock options. In addition, Roth was given a \$5.6 million bonus for

<sup>39</sup>Prior to 1998, Cisco had made 21 acquisitions since 1993, Nortel six since 1990, Lucent four since 1996 (before which it had been part of AT&T) and Alcatel (which had been a conglomerate) six in telecommunications since 1991 (Carpenter and Lazonick, 2002; Paulson, 2001: 291–294).

2000, on top of a \$4.2 million bonus the previous year. In 2000, another four senior Nortel executives whose incomes the company reported shared net gains of \$51.4 million from exercising stock options (83% of their total earnings) and another \$5.7 million in bonuses. In 2000 the five highest paid Nortel executives received 1.9% of the options that the company awarded. In 2001, in addition to the repricing of options, and presumably to make up even more for the fall in the stock price, the top five received 7.9% of all options granted. In 2002, however, their share was reduced to 1.5% (*Nortel Networks 2001 Proxy Statement*: 7–10; *Nortel Networks 2002 Proxy Statement*: 7–10; *Nortel Networks 2003 Proxy Statement*: 12).

After its spinoff from AT&T, Lucent continued its former parent's practice of granting stock options to executives for the purpose of 'encourag[ing] selected key employees . . . to acquire a proprietary and vested interest in the growth and performance of the Company' and 'to enhance the ability of the Company and its Affiliates to attract and retain individuals of exceptional managerial talent' (*Lucent Technologies 1996 Proxy Statement*: 15). Lucent also established a one-time 'Founders Grant Option Plan' in which every employee of Lucent received 100 options, and which accounted for 50% of the options granted in 1997. In addition, Lucent assumed the stock option plan of its major 1997 acquisition, Octel Communications, a 3000-person company based in Silicon Valley. These assumed stock options represented 10% of the total options that Lucent granted that year, and, per Octel employee, averaged more than eight times the number of options that Lucent gave to current employees under the Founders Plan (*Lucent Technologies 1997 Annual Report*: 57–8). The following year Lucent reduced the total number of options that it granted by almost 20%, notwithstanding a one-time 'Global Stock Option Plan' for worldwide managers that absorbed 39% of the 1998 option grants as well as options assumed of acquisitions that absorbed another 12% (*Lucent Technologies 1998 Annual Report*: 62).

Without special programs, Lucent's stock option grants in 1999 were about one-half the level of the previous year, indicating that there was little movement at the company to broaden the base of stock option recipients among its current non-executive employees. In 2000, at the peak of the boom, however, the number of stock options that Lucent granted increased to more than four and a half times the number granted the previous year, presumably because of the options that Lucent assumed in its high-priced acquisition spree along with the need to dole out more options in order to retain these highly mobile employees (*Lucent Technologies 2000 Annual Report*: 42). The number of options assumed in the acquisition of Ascend alone was 65 million, representing more than the total number of options granted in 1999 or some 23% of all the options granted in 2000 (*Lucent Technologies 1999 10-K*: 12).

In 2001 Lucent issued 22% more option grants than it did in 2000 as it tried to make up for a plummeting share price; the average weighted exercise price of options granted was \$47.68 in 1999 and \$47.95 in 2000, but \$12.56 in 2001 (*Lucent Technologies 2001 Annual Report*: 39). On February 21, 2001, with most of its employees' option grants under water, the company made a special '1 for 2' stock option grant to all employees

worldwide who held options with a grant price greater than \$12.14 (the market price of the stock prevailing on that date). Lucent claimed that this grant covered 72 000 employees holding 142 million shares (an average of 1972 shares per employee, although we have no information on the actual distribution of these shares). These grants had a two-year vesting period and a five-year exercise period, with 'a special feature that provides for accelerated vesting and expiration if the Lucent stock price reaches and remains above a closing price of \$50.00 for ten consecutive trading days'. With its stock price falling further to under \$7.00 by the following July, however, Lucent decided to accelerate its fiscal 2002 annual stock option grant, involving 62 000 employees and 78 million shares—to 'give [employees] a more personal stake in Lucent's turnaround' (*Lucent Technologies 2002 Proxy Statement*: 24–5). As even these new options plunged well under water over the following year, Lucent provided employees with a 'Stock Option Exchange Offer' that in May 2002 resulted in the voluntary cancellation of over 213.2 million under-water grants—well over one-third of Lucent's total options outstanding—with an average exercise price of \$30.22 in exchange for a 're-grant' of 110.6 million options at the current market price the following November (*Lucent Technologies 2003 Proxy Statement*: 57–8). On the date of the re-grant issue, Lucent's stock closed at \$1.51.

During 2002, with virtually all vested options under water, Lucent employees exercised options for a mere 23 699 shares (*Lucent Technologies 2002 Proxy Statement*: 20). In contrast, 31.0 million options had been exercised in 1999, 75.0 million in 2000 and 10.5 million in 2001 (*Lucent Technologies 2001 10-K*: 74). Lucent's top executives were active exercisers. In the five years between 1996 and 2002 that Schacht was on the payroll as a Lucent executive, his remuneration was a total of \$73.1 million, of which 89% was from a net gain of \$65.0 million from the exercise of stock options in 1998, when he stepped down as chairman for the first time. Schacht had reaped 4.3% of the options awarded in the company in 1996 and another 3.9% in 1997.

The exercise of options was not, however, the only way in which Lucent's top executives could realize multi-million dollar pay packages. Of McGinn's total remuneration of \$61.9 million from 1996 through the first month of fiscal 2002, when he was ousted, less than 6% was from the exercise of stock options (the proportion of Lucent's option grants received by McGinn ranged from a low of 1.1% in 2001 to a high of 2.7% in 1999). Just over 32% of McGinn's total remuneration for 1996–2002 came from bonuses—in 1998, for his 'outstanding performance', the Lucent board awarded him 'a special one-time bonus payment' of \$7.4 million on top of his 'regular annual bonus' of \$4.4 million (*Lucent Technologies 1999 Proxy Statement*: 37)—while another 32% came from restricted stock awards. When McGinn was fired in October 2001, it was with a \$12.5 million severance package plus a company pension of \$870 000 per year (*Lucent Technologies 2002 Proxy Statement*: 30). Patricia Russo received a total of \$33.1 million in remuneration from Lucent in her five years with the company from 1996 to 2002 (she was elsewhere in 2000 and 2001), of which 15% was from exercising stock options, 58% from restricted stock awards and 18% from annual bonuses. In

2002 Russo received 54.4 million option grants, which represented 35% of all grants awarded that year.<sup>40</sup>

In addition, the board gave Deborah Hopkins, who came from Boeing to Lucent as CFO in April 2000 and resigned from the company just over a year later, a \$4 million signing bonus plus another \$650 000 regular bonus, plus another \$3.7 million in restricted stock. As a result, her total remuneration for 2000—a year in which Lucent committed its worst financial misdeeds—was \$9.5 million, even without any stock option income (*Lucent Technologies 2002 Proxy Statement*: 34). In December 2001 two senior executives—Robert Holder and William O'Shea—received payments of \$4.5 million and \$3.1 million respectively, plus full vesting of current outstanding stock options and restricted stock units, on the sole condition that they remain in the employ of the company until 'April 22, 2002 or upon commencement of employment of a new CEO, whichever comes first' (*Lucent Technologies 2002 Proxy Statement*: 35).<sup>41</sup>

Alcatel's board first authorized the granting of stock options in 1990, with the first grants being made to executives in 1994 and further grants in 1996 and 1997. In December 1998 Alcatel 'decided to extend its grant of stock options to specialists, young high-potential employees and future executives as well as to members of senior management', thus doubling the number of recipients to 2000 employees (*Alcatel 1998 20-F*: 53). Two-thirds of these employees were based outside of France. The number of shares granted in the plan was 11.6 million, less than 0.6% of the company's outstanding shares. Alcatel specifically indicated that its recently approved stock repurchase program would be used to fund these stock option grants. Unlike the North American companies, there was a company performance criterion attached to the grants; they would only be exercisable if Alcatel's income from operations would be at least 6.5% of total sales for the year ending December 31, 2000 (it was in fact 7.17%) or 7.5% for the year ending December 31, 2001 (when, as it turned out, income from operations was negative) (*Alcatel 1998 20-F*: 54).

As Alcatel stepped up its US acquisitions, the allocation of Alcatel's options became heavily biased toward US employees. As of December 31, 1999, employees of Alcatel USA had 20.9 million options outstanding as a result of option plans to replace existing programs that the US companies negotiated with Alcatel when it acquired them. In addition, Alcatel issued new grants of eight million shares in the last four months of 1999 'for the benefit of key employees of US companies in the Telecom sector' (*Alcatel 1999 20-F*: F-32). Moreover, whereas the vesting period for options for employees in France was five years, the vesting period for employees in the USA was 25% after one year and 2.5% each month thereafter.

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<sup>40</sup>While the number of option grants reflected the terms on which Russo was recruited as CEO, the extraordinarily high proportion of all Lucent 2002 grants that she received was the result of the acceleration of the 2002 company-wide grant program, which meant that most employees received their 2002 option awards in fiscal 2001.

<sup>41</sup>A third senior executive, Ben Verwaayen, was also offered a retention bonus of \$3.3 million, but decided to leave Lucent to become CEO of BT.

In its *2000 Annual Report* (19), Alcatel stated that it was 'reviewing its stock option plans in order to increase its competitiveness, which includes a significant increase in the number of eligible employees and availability rules similar to those offered by its North American competitors'. In 2000 Alcatel issued 15.2 million options to about 3900 employees through its regular option plan, plus another 8.9 million options to almost 59 000 employees as part of a stock offer to employees of four stock options for each share purchased. During the same year Alcatel issued 23.9 million stock options to Newbridge employees as partial payment for the acquisition of the company (*Alcatel 2000 Annual Report*: 65–66). In October 2000 Alcatel also created a tracking stock ('O' shares) for its optical components division, so that its highly mobile personnel would have a market valuation for their stock-based compensation distinct from that prevailing in the company as a whole.<sup>42</sup>

Subsequently, in March 2001 Alcatel rationalized its stock option system worldwide. Most significantly Alcatel cancelled the separately administered US plan in favor of a unique corporate plan, denominated in Euros using Alcatel shares (rather than ADSs, as had previously been the case with the North American options). Within this context, the numbers of options granted and employees eligible increased dramatically; 37.7 million options were issued to almost 31 000 employees worldwide in March 2001, and another 27.9 million options to over 25 000 employees in December 2001 (*Alcatel 2002 20-F*: 81). Employees of companies registered in France still had to wait four years from the grant date before the options vested, while for most other employees the vesting schedule was 25% of the options after the first year and 1/48th of the options for each month thereafter. To implement this plan corporate headquarters systematized the analysis of differences in labor competition in different parts of the world as a basis for determining the allocation of option grants that regional managers would have available for distribution to their employees, and also tied the distribution of these options within regions much more closely to salary structures than had previously been the case.<sup>43</sup> In addition, during 2001 and 2002, the Alcatel CEO had the right to grant options to new employees (and under exceptional conditions existing employees), and in fact granted over three million A shares and almost 200 000 O shares to about 1300 employees during these two years (*Alcatel 2002 20-F*: 82).

While by no means poorly remunerated, the income of Alcatel's top executives was considerably less than those of their counterparts at Cisco, Nortel, and Lucent in both the boom and decline.<sup>44</sup> The salary and bonus of 11 Alcatel executive directors

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<sup>42</sup>In the event, the Optronics tracking stock *per se* generated no net income for the division's options recipients. When the 'O' shares were reconverted to regular Alcatel ('A') shares in April 2003, no 'O' options had been exercised (*Alcatel 2002 20-F*: F-165).

<sup>43</sup>The information on the 2001 plan draws on an interview by two of the authors of Jean-Luc Corniglion, director of remuneration, Alcatel, on July 15, 2002.

<sup>44</sup>Alcatel supplies data on executive compensation in its annual 20-F SEC filings, but unfortunately these data are neither in the same form nor as detailed as that supplied by the North American companies in their Proxy Statements.

averaged \$689 000 in 1999, \$680 000 in 2000, \$700 000 in 2001 and \$662 000 in 2002, while (not including option income) the ratio of their average pay to that of all Alcatel employees over these four years was 11.7, 12.7, 11.2 and 9.7. Tchuruk's salary and bonus as CEO was \$2.5 million in 2001. The second highest paid Alcatel executive that year was Prabhu, head of Alcatel's US operations, with \$1.6 million in salary and bonus, and the third highest was Jean-Pierre Halbron, chief financial officer, with \$1.1 million. Tchuruk exercised options on 250 000 A shares in 2001 priced at €12.96 (about \$11.85). We are not informed of his net gain from exercising these options, nor when during the year he did so. If he had exercised them at the beginning of January 2001, when the Alcatel price was at its peak for the year, he would have netted about \$11 million; if in the middle of the year about \$1 million (*Alcatel 2001 20-F: 61*). In 2002 Tchuruk's total remuneration was \$1.6 million, made up entirely of salary; he was paid no bonus, and neither exercised existing options nor received new ones (*Alcatel 2002 20-F: 77*).

*Cash.* In the last half of the 1990s, of the three Old Economy companies, only Lucent went to the stock market for cash, and in Lucent's case it was on the occasion of being listed as a new company when it was spun off from AT&T in 1996. In its IPO, Lucent raised \$2.9 billion on the stock market by issuing 112 million shares, representing 17.6% of its common stock outstanding (see Table 13). Lucent did not use the cash thus raised to fund its new investments, but rather to restructure its balance sheet; most of the funds were used to pay off about 60% of the \$3.7 billion of AT&T's existing long-term debt that Lucent had assumed in the spinoff.

In the decline of 2001–2002, as their financial shortfalls mounted, the stock market became important as a source of cash for Nortel and Lucent, mainly because their downgraded bond ratings made it impossible for them to issue long-term debt. In the case of Lucent, in August 2001 it did a preferred stock issue that netted \$1.83 billion, and in March 2002, when its bond rating had been cut for the fifth time in 16 months, it did a more complicated deal in which it set up a trust to issue preferred securities and then had the trust buy 7.75% convertible subordinated debentures from Lucent for a net cash inflow of \$1.75 billion. In Nortel's case, also in financial straits, in June 2002 the company issued 632.5 million common shares, equal to almost 20% of its outstanding stock at the time, raising \$863 million. In addition, concurrently, Nortel generated another \$623 million by selling 28 750 equity units involving a prepaid purchase contract that entitled the holder to receive Nortel common shares and specified zero-interest US treasury securities (*Nortel 2002 Third Quarter Shareholders Report: 73*).<sup>45</sup> This financial manoeuvre pushed the full dilutive impact of the stock issue into the future.

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<sup>45</sup>The report states: 'During the three months ended September 30, 2002, 27 [of the 28 723] purchase contracts were settled resulted in 432,298 common shares being issued.' If all contracts had been settled by September 30, 2002, Nortel's shares outstanding as of that date would have been diluted by about 12%.

**Table 13** Stock as a source of cash: Nortel, Lucent and Alcatel, 1996–2002<sup>a</sup> (\$ millions, except dividends per share, which is in \$; uses of funds are given in parentheses)

	1996	1997	1998	1999	2000	2001	2002
Nortel							
Sale of stock on the market	0	0	0	0	0	0	1486 <sup>b</sup>
Issue of stock to employees	482	418	125	521	479	146	0
Cash dividends	(133)	(162)	(203)	(236)	(223)	(123)	0
Cash dividends per common share	0.06	0.07	0.06	0.08	0.08	0.04	0.00
Stock repurchases	0	(452)	(217)	(14)	0	0	0
Lucent							
Sale of stock on the market	2887	0	0	0	0	1831 <sup>c</sup>	1750 <sup>d</sup>
Issue of stock to employees	0	260	608	696	1444	224	64
Cash dividends	(48)	(192)	(201)	(222)	(255)	(204)	(149)
Cash dividends per common share <sup>e</sup>	0.02	0.08	0.08	0.08	0.08	0.06	0.00
Stock repurchases	0	0	0	0	0	0	0
Alcatel							
Sale of stock on the market	0	0	0	0	0	0	676 <sup>f</sup>
Issue of stock to employees	6	84	287	105	1399	7	8
Cash dividends	(177)	(295)	(306)	(373)	(477)	(504)	(289)
Cash dividends per common share <sup>g</sup>	0.39	0.41	0.45	0.48	0.46	0.14	0.23
Stock repurchases	0	0	(508)	(612)	(672)	0	0

Sources: *Company annual reports*; <http://research.stlouisfed.org/fred/data/exchange.html>

<sup>a</sup>Fiscal years ending December for Nortel and Alcatel, and September 30 for Lucent.

<sup>b</sup>Sale of common shares generated \$863 million; sale of prepaid purchase contracts generated \$623 million.

<sup>c</sup>Issuance of 8% redeemable convertible preferred stock.

<sup>d</sup>Issuance of company-obligated 7.75% mandatorily redeemable convertible preferred securities of subsidiary trust.

<sup>e</sup>On July 24, 2001 Lucent announced that it would discontinue dividend payments on common shares. All of the dividend payments recorded for 2002 are on preferred shares outstanding from the 2001 preferred stock issue.

<sup>f</sup>Proceeds from the issue of notes mandatorily redeemable for shares.

<sup>g</sup>Alcatel dividends per share in French francs (through 2000) and Euros were converted into US dollars using the average of the exchange rates prevailing at the end of December of the previous year and the end of December of the current fiscal year.

As Table 13 indicates, all three companies did raise cash in various years since the mid-1990s from the sale of stock to employees who exercised their stock options. In 2000 Lucent raised over \$1.4 billion in this way, while Alcatel raised \$1.3 billion when

employees exercised their stock options plus another \$100 million when it sold shares to employees who received stock options for every share they purchased (*Alcatel 2000 20-F: F-33*). At the same time, Nortel and Alcatel (but not Lucent) strategically engaged in stock repurchases to supply shares to their stock option programs and support their stock prices. For example, it was in the wake of a 38% fall in its share price in one afternoon in September 1998 in response to an earnings warning that Alcatel began to repurchase shares.<sup>46</sup> Whereas Cisco engaged in stock repurchases to try to offset the stock market decline in 2001–2002, financial difficulties precluded Nortel, Lucent and Alcatel from pursuing this financial strategy.

Indeed in 2002 Nortel and Lucent stopped paying dividends on their common shares, as did Alcatel in 2003.<sup>47</sup> Lucent, however, was obliged to pay \$149 million in dividends on the preferred shares that it had issued in 2001. For both Nortel and Lucent, the stock market had become a source of cash in 2001–2002, but in a way that was highly dilutive of shareholdings and that undoubtedly helped push down the price of their stock to the point that both companies asked their shareholders to authorize reverse stock splits, should they be needed to prevent delisting from NYSE.<sup>48</sup>

## 6. The accumulation of innovative capability

How did the attempts of these three Old Economy companies to rely on the stock market to help them make the transition to the New Economy affect their accumulation of innovative capability? While the developmental character of the innovation process means that some key outcomes still remain to be seen, we have gathered sufficient information, much of it publicly available, to provide some initial answers to this question. In this section of the paper, we will focus on the impacts of the use of stock as a currency to accumulate capability on each of the three 'social conditions of innovative enterprise':

1. What was the impact on strategic control? Did the use of stock as a combination and compensation currency lead executives to make allocative decisions in the 1998–2000 boom that contributed to the problems of the companies in the 2001–2003 decline?
2. What was the impact on organizational integration? Did the use of stock as a combination and compensation currency promote or undermine the processes of collective learning that are central to the accumulation of innovative capability?
3. What was the impact on financial commitment? Did the use of stock as a combination and compensation currency promote or undermine access of companies to finance to sustain innovation processes until they could generate returns?

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<sup>46</sup>'Alcatel management to propose a share buy back program,' Alcatel press release, September 18, 1998.

<sup>47</sup>'Alcatel reports fourth quarter and full year 2002 results,' Alcatel press release, February 4, 2003.

<sup>48</sup>*Lucent 2002 Proxy Statement: 34; Nortel 2002 Third Quarter Shareholders Report: 74.* NYSE can delist companies whose shares trade at less than \$1.00 for 30 consecutive days.

### 6.1 *Strategic control*

The importance of stock options in determining the pay of top executives meant that they had a powerful personal interest in maintaining the growth of their company's stock price. The wider distribution of stock options that occurred at Nortel, Lucent and Alcatel during the New Economy boom broadened the support for corporate strategies that focused on boosting stock prices. At the same time, strategic control at all of these companies was exercised by career managers who understood what was required to build an organization that must compete for market revenues to survive. It is inherent in an innovative strategy that it confronts technological, market, and competitive uncertainties. The fact that the innovative strategies pursued by Nortel, Lucent and Alcatel did not yield expected returns is not in and of itself evidence that the use of stock as a combination and compensation currency undermined the ability and incentives of strategic decision makers to confront those uncertainties. Insofar as the use of stock as a currency to accumulate innovative capability may have had a negative impact, however, it may have been because experienced and knowledgeable strategic decision makers became overly focused on, and indeed perhaps even obsessed by, the need to make allocative decisions that they thought would help boost their company's stock price.

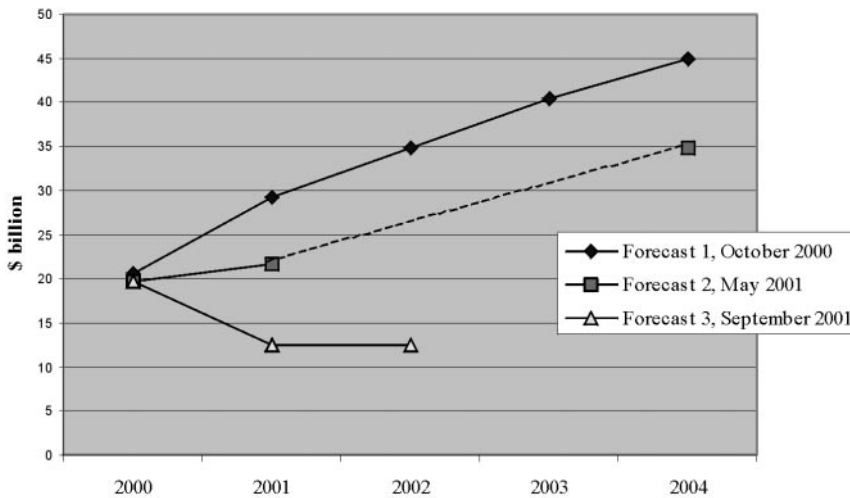
In making decisions to invest in new technology during the New Economy boom, executives in the optical networking industry had to take a position on a highly uncertain, yet critical parameter, namely, the growth of market demand for their existing and potential products over a one- to three-year period. In predicting market growth, all of the companies tended to rely heavily on market forecasts by specialized industry research firms, particularly RHK and Dell'Oro<sup>49</sup>—forecasts that in the boom years painted an extremely rosy picture of the future.

When the global optical transport market was at its peak of \$23.0 billion in 2000, for example, Dell'Oro Group projected it would grow to \$57.3 billion by 2005 (Dell'Oro press release, January 18, 2001). When revenues actually fell to \$17.7 billion in 2001, these optimistic forecasts were dramatically scaled down. Another research consultant (Jeffries & Company 2001: 30) cited Dell'Oro's August 2001 forecast of flat revenue growth for 2002 and \$18.1 billion revenues for 2003. One year later, in August 2002, Dell'Oro predicted revenues for 2004 of only \$8.1 billion (Dell'Oro press release, August 1, 2002).

Similarly, in 2000 RHK had optimistic projections for the North American optical transport market whose revenues had grown from \$12.3 billion in 1999 to \$19.6 billion in 2000. In October 2000 RHK noted that the market would not sustain the 67% growth experienced in 2000, but it nonetheless predicted growth rates of 42% in 2001, 19% in 2002, 17.5% in 2003 and 11% in 2004. RHK thus projected that the North American

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<sup>49</sup>RHK describes itself as 'the premier research and advisory services firm assisting the world's leading telecommunications companies' ([www.rhk.com](http://www.rhk.com)). Dell'Oro describes itself as 'a market research firm that specializes in strategic competitive analysis in the networking and telecommunications industries' ([www.delloro.com](http://www.delloro.com)).



**Figure 6** Three successive RHK forecasts for the growth of the North American optical transport market from late 2000.

Sources: RHK press releases: October 20, 2000, June 4, 2001 and September 4, 2001.

optical transport market would reach \$45 billion in 2004 (see Figure 6; RHK press release, October 20, 2000). By May 2001 RHK realized its forecasts were overly optimistic, and reduced its 2002 forecast from \$35 billion to \$22 billion. Just three months later, in September 2001, RHK further scaled down its forecasts to reflect an actual decline of 36% in North American optical transport market revenues for the first half of 2001. Instead of the predicted \$29.3 billion, revenues for the year underway were seen as likely to amount to only \$12.5 billion, with little likelihood of growth beyond that figure for 2002.

The explanation for this change given by RHK founder, principal and chief analyst, John Ryan, was that 'since our last forecast, we completed another round of interviews with carriers, who account for 95% of carrier spending. We found that carriers dramatically shifted their purchasing and operational behavior to match the unprecedented change in competition and economics experienced in this market.'<sup>50</sup>

By predicting the original explosion of demand for optical networking equipment with the most enthusiastic forecasts available in 2000, RHK established its credentials in the market for information on this high-growth industry. Simultaneously, more and more analysts and investment bankers began to cover the rapidly developing optical

<sup>50</sup>RHK press release, September 4, 2001. In March 2003, RHK removed from its website the press releases from which we have drawn our account of the company's changing forecasts in 2000 and 2001. In reporting on the disappearance of these press releases, *Light Reading* observed: 'One thing is clear: RHK is trying to downplay its past as a hype-heavy firm whose numbers helped fuel the expectations of the telecom bubble. Granted, RHK didn't just make up its forecasts, but the telecom economy's wild swings in the late 90s and early aughts certainly bit the firm in the backside more than once' (Harvey, 2003).

networking industry, thus increasing the circulation of optimistic views of the market potential. In its first report on the topic in May 1999, Merrill Lynch (1999) identified optical networking as one of the fastest growing segments of telecom equipment with annual overall growth rates of 40%, but predicted a relatively modest market for optical components of \$8.1 billion in 2001. By February 2000, Merrill Lynch (2000) had published a second report in which it described optical networking as 'the hottest topic in North America at the moment and . . . probably for the next few years'. In this report, it quotes Alcatel as having estimated that 'the global terrestrial transmission market will grow to \$20 billion by 2001' (Merrill Lynch, 2000: 7) and RHK data on the submarine market that 'will add between \$25 billion and \$28 billion over the next five years' (Merrill Lynch, 2000: 10).

In initiating coverage of 'Networking, optical and telecom equipment' in July 2000, Salomon Smith Barney (2000: 12–15) called upon the forecasts of both RHK and Dell'Oro to highlight the 'stellar growth' predicted for the data networking markets. RHK data are used, for example, to illustrate the impressive annual growth rates in the DWDM and SONET markets forecast from 1998 through 2003 (40 and 20% respectively). A Deutsche Bank (2001: 1) Equity Research report from June 2001 optimistically concluded that RHK's first revised forecast nevertheless signaled 'a shift away from legacy towards next-generation optical product areas'.

Quite apart from the inherent uncertainty concerning technological and market trends in the optical networking industry, a major problem with the revenue projections of firms such as Dell'Oro and RHK appears to have been that the many competitors from whom the data were collected all were acting as if each one would capture a larger share of the market than in the aggregate could actually be the case, with overly optimistic forecasts in 1999 and 2000 and dramatic overcapacity in 2001 and beyond being the results. According to a former chief technology officer at AT&T, quoted in a *Financial Times* series on 'The telecoms crash', 'the amount that households spend on telecommunications . . . is fairly static at \$1000 a year. You can imagine some substitution within that—and a few new broadband services like video on demand make take spending away from other leisure activities—but ultimately there is no pot of gold' (Roberts, 2001).

These inflated forecasts of potential market growth justified soaring stock prices. Thus, optical networking executives who relied on their company's stock as a combination and compensation currency had strong incentives to accept these forecasts as valid for decision making purposes. Indeed, given the speculative stock market that prevailed in 1999 and 2000, it is plausible that if a company had not acted as if these forecasts were valid by allocating resources to investments in new technology—and especially to the acquisition of 'next-generation' start-ups—the market would have punished their stock price, and would have thus put the company at a competitive disadvantage in acquiring companies and attracting/retaining employees. Beyond such forecasts, the best indicators of prospective demand were the orders that service providers were placing with them. But with speculation also driving up their stock prices, the strategic

decision makers at the service providers also had an interest in optimistic growth forecasts, and over-invested accordingly (Suria *et al.*, 2000; Harvey, 2002a).

The Old Economy companies were not alone in coping with this uncertain market environment. In fiscal 2001 Cisco reported its first loss ever as a public company of slightly over \$1.01 billion for the three months ending April 30, 2001, caused by an excess inventory charge of a \$2.5 billion—the largest inventory write-off in business history up to that date. In the summer of 2000 optical networking companies had experienced severe shortages of components that translated into lost sales. As a result, Cisco had decided to enter into agreements with suppliers that committed it to buying specific quantities of components. It had also committed to help suppliers accumulate stock by offering them \$600 million in interest-free loans. Given its dependence on outsourcing, when the market slowdown came in early 2001, Cisco chose to honor all its contracts with suppliers and absorb the loss (Harvey, 2001b).

For all of the optical networking companies, both Old and New, high stock prices depended on high levels of reported sales. A practice that helped push up sales was 'vendor financing', whereby optical networking companies became substantial creditors in order to secure customers for their products. Vendor financing was especially meted out to the new entrants among the telecommunications service providers. Unencumbered with legacy systems, new companies such as Global Crossing, Level 3, and Winstar demanded 'next generation' optical networks from the equipment suppliers. At the end of 2000 Cisco had \$2.5 billion in commitments to buyers of its equipment, of which \$625 million had been drawn down; Nortel \$2.1 billion in commitments with \$1.4 billion drawn down; Alcatel \$1.5 billion in commitments, with the amount drawn down undisclosed; and Lucent \$7.0 billion in commitments, of which \$1.6 billion had been drawn down (Harvey, 2000). For example, using vendor financing, Lucent 'won' a \$2 billion order from Winstar, a company with 1999 losses of \$900 million (Reardon, 2001). Winstar is just one of the 67 major telecommunications service providers that as of October 2002 had gone bankrupt since 2000 (Raynovich, 2001). As a result, the equipment companies not only lost their 'next-generation' customers but also were saddled with bad loans.

Another practice that could increase the volume of sales that the companies could show on their books was 'channel stuffing'—the booking of sales on shipped product preceded by private agreements with distributors that they did not have to pay for goods that they did not subsequently sell. In November 2000, after CEO McGinn was ousted, Lucent revealed that it had improperly booked \$679 million in revenue during the 2000 fiscal year (Jander, 2000a, 2001a). While the SEC took no action on this particular admission, in October 2002 it served notice on Lucent of a possible civil lawsuit over improper accounting in 1999 and 2000 to inflate its sales figures (Farrell, 2002). The company has also been the target of class-action shareholder lawsuits over this issue.<sup>51</sup>

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<sup>51</sup>See 'Lucent settles lawsuits,' *Light Reading*, March 28, 2003.

It was to gain rapid access to the 'next-generation' technologies that would be needed to deliver on these orders that the strategic managers of the optical networking companies snapped up start-ups in 1999 and 2000, using their inflated stock as the acquisition currency. During 1999–2000, Nortel, Lucent, Alcatel and Cisco issued stock worth \$100.9 billion to make acquisitions (Table 12). At Nortel in particular strategic decision makers appear to have been taken in by the hype about the speed with which 'next-generation' technology would diffuse. Take, for example, the  $\chi$ ros acquisition. Nortel made this acquisition after Lucent's Bell Labs had developed an optical switch, the LambdaRouter, that was deployed for testing in September 2000 and that was generating revenues by May 2001 (although its first customer was the 'next-generation' service provider, Global Crossing, which by early 2002 had gone into bankruptcy).<sup>52</sup> To access the same technology, Nortel acquired  $\chi$ ros, a start-up with an unproven technology and 90 employees, for \$3.23 billion in stock in June 2000 (Heywood, 2000a, b).  $\chi$ ros was among four acquisitions that Nortel had made between January 2000 and February 2001 at a cost of \$15.9 billion and that absorbed about 8% of Nortel's shares outstanding. At the end of June 2001 Nortel wrote down these \$15.9 billion worth of investments by \$12.4 billion (*Nortel Networks 2001 Annual Report*: 30).

In and of itself, such a write-down does not prove that the acquisition represented a misconceived technology strategy; rather it just shows that the company spent too much 'shareholder value' to make the acquisition. From the technological perspective, however, the problem is that Nortel has not generated a commercializable product from the  $\chi$ ros acquisition; in March 2002 Nortel cancelled the development of the  $\chi$ ros product (Jander, 2001b; Carpenter and Lazonick, 2002; Jander and Saunders, 2002). What capability has Nortel retained from such an investment? Two editors of *Light Reading* (Jander and Saunders, 2002) report that

[d]espite the canning of the  $\chi$ ros project, sources inside and outside the company say Nortel plans to make the best of what it bought. Efforts are underway to merge elements of the  $\chi$ ros crossconnect with smaller switch chips, they maintain. The results, of course, remain to be seen. Meanwhile, the waters have closed over the once-bright promise of Nortel's 'jaw-breaking' all-optical switch.

It appears that  $\chi$ ros was not Nortel's only strategic misstep with stock-based acquisitions. In addition, Clarify, which Nortel purchased for about \$2.1 billion in stock in October 1999, was sold for \$200 million in cash in October 2001 (Jander, 2001e), while Coretek, which Nortel purchased for \$1.4 billion in stock in March 2000, was closed down in September 2002 (Rigby, 2002). The problem for Nortel in the decline, however, is not just, or even primarily, that it used inflated shares to make these acquisitions (for this perspective, see Fuller and Jensen, 2002). The problem is that

<sup>52</sup>'Lucent switch in transatlantic test,' *Light Reading*, September 26, 2000; 'Lucent ships LambdaRouters,' *Light Reading*, May 15, 2001.

there appears to be so little innovative capability that has remained in the company that can be traced to these 'strategic' investments.<sup>53</sup>

If, with the use of stock as a currency for accumulating innovative capability, Nortel's strategists appear to have lost sight of what it takes to develop complex technological systems, some of Lucent's top executives appear to have made strategic acquisition decisions based on opportunity for private gain or an ignorance of the innovative capability that their company already possessed. In the press, McGinn has particularly been singled out for a change in his strategic behavior during the boom. In the aftermath of his dismissal from the company, he was accused of having taken, while he was Lucent's CEO, a very large personal financial stake in a start-up, Zhone, that was producing a competitive product and that had been founded by the ex-CEO of Ascend, Mory Ejabat, after that company had been acquired by Lucent for \$24 billion in 1999 (Raynovich, 2000a). Lucent was also embarrassed by revelations that when it acquired the revenue-less start-up Chromatis Networks for \$4.5 billion in stock in June 2000, it already possessed, through its acquisition of Ignitus, which it had completed at a cost of \$33 million just two months earlier,<sup>54</sup> the same technology as the one that Chromatis was developing—and that the development of the Ignitus technology was at more advanced stage. Having acquired Chromatis, two months later Lucent cancelled further development of the Ignitus product. One year later, in August 2001, Lucent shuttered the Chromatis operations, which had failed to generate a commercializable product (Jander, 2000b, c, 2001e).

As already noted, Alcatel was the only optical networking company outside of North America that was able to use its stock as an acquisition currency. Ironically its major failure in the USA was Packet Engines, an Ethernet equipment company in Spokane, Washington for which in October 1998 Alcatel paid \$315 million in cash. Overall Alcatel appears to have fared better than Lucent and Nortel in its acquisition strategy, in part because it was unwilling or unable to dispense billions of dollars worth of stock to acquire unproven start-ups during the acquisition mania of 2000. While, as Table 12 shows, Alcatel spent almost as much as Lucent in the 2000 calendar-year, most of this expenditure was for Newbridge Networks, Alcatel's major ATM acquisition (analogous

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<sup>53</sup>Of the \$3.23 billion purchase price of  $\chi$ ros, Nortel attributed \$29 million to acquired technology, \$191 million to in-process research and development (IPRD), and \$3 million to net tangible assets, with the remainder—\$3.0 billion, or 93% of the purchase price—being accounted for as goodwill. In presenting these data for  $\chi$ ros and other 2000–2001 acquisitions in its 2002 10-K filing Nortel warns: 'The forecast data employed in the analyses of IPR&D was based upon both forecast information maintained by the acquired companies and Nortel Networks estimate of future performance of the business. The inputs used by Nortel Networks in analyzing IPR&D were based on assumptions that Nortel Networks believes to be reasonable but which are inherently uncertain and unpredictable. These assumptions may be incomplete or inaccurate, and no assurance can be given that unanticipated events and circumstances will not occur' (*Nortel Networks 2002 10-K*: F-35).

<sup>54</sup>Lucent already owned 56% of Ignitus when it acquired the remaining 44% on April 4, 2000 (*Lucent Technologies 2002 Annual Report*: 32).

to the acquisitions of StrataCom by Cisco in 1996, Bay Networks by Nortel in 1998, and Ascend by Lucent in 1999). When Alcatel acquired Newbridge, it was a 14-year-old company, with over \$1.2 billion in revenues, \$123 million in net income, over 6300 employees, a proven technology and well-developed distribution channels. Whereas the cost per employee of Alcatel's Newbridge acquisition was \$1.1 million, the cost per employee of Lucent's Ascend acquisition was \$14.6 million. Perhaps because of the high price paid for Ascend—which made the stock options of the company's 3000 employees worth about \$3 billion—many Ascend employees, like CEO Ejabat, chose not to work for Lucent after the acquisition (Solomon, 1999a, b).

Alcatel was not averse to making 'next-generation' acquisitions, but it preferred to wait until the price was right. For one thing—and this has more to do with organizational integration than strategic control—Alcatel's executives recognized that if they made the acquisition at too high a price, it would be difficult to retain key people, suddenly rich, after the acquisition.<sup>55</sup> In November 2000, Alcatel was in the market for a metro optical networking start-up, with Astral Point Communications as its top candidate. But it balked at paying the \$1–2 billion in stock, or 20–40 million Alcatel shares, that such a company would have commanded at the time (Raynovich, 2000b). Alcatel waited, and in January 2002 bought Astral Point for \$135 million in stock (Jander, 2002c), representing just nine million Alcatel shares. By delaying until the stock market had dropped and the competitive bidding for start-ups had ceased, Alcatel made the acquisition using only 25–45% of the shares and 7–14% of share value that it would have expended in the boom. Whether, in terms of innovative capability, Astral Point will be a successful acquisition for Alcatel remains to be seen. But judging from the failure of many of the start-up acquisitions made in haste, not to mention at high cost, by Nortel and Lucent during the boom, one might be justified in thinking that this manner of more deliberate start-up acquisition stands a better chance of innovative success.

Cisco's experience with some of the acquisitions that it made in 1999 and 2000—when it acquired a total of 41 of its 79 acquisitions through March 2003—provides some (albeit at this point limited) evidence for this point of view. In April 2001 Cisco discontinued its Monterey router product; according to *Light Reading*, 'Cisco bought the wrong optical switch with Monterey and ended up admitting defeat and scrapping it' (Jander, 2002d). *Light Reading* called Cisco's Pirelli Optical Systems acquisition, 'another dud; in May 2001 Cisco sold its South Carolina DWDM manufacturing facility, based on a product line acquired with the Pirelli purchase, to Solectron, a major contract manufacturer (Harvey, 2001a, c). In October 2002, Cisco closed the Swedish plant of its start-up acquisition, Qeyton Systems, which it had purchased for \$800 million in stock in May 2000, although the company claimed that it would continue selling the metro DWDM product based on the technology that had been developed at Qeyton (Harvey, 2002e).

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<sup>55</sup>Interview by two of the authors of François Béhague, vice-president technology and development, Alcatel, July 15, 2002.

## 6.2 Organizational integration

We have defined organizational integration as a set of relations that creates incentives for people to apply their skills and efforts to engage in collective learning processes. Organizational integration requires the alignment of two, often contradictory, roles that corporate incentive systems play: *managing the labor market* (a *recruitment/retention* function) and *managing the learning process* (a *motivation* function). Managing the labor market focuses on individual incentives, since it is as individuals that employees decide whether or not to work for a company. Managing the learning process focuses on collective incentives, since the learning process requires that people in a variety of functional specializations and hierarchical positions cooperate with one another in applying their skills and efforts to the pursuit of organizational goals.<sup>56</sup> The two functions of incentive systems can become misaligned if a company becomes too focused on individual incentives—that is, giving out rewards just to recruit or retain people—without assessing the consequences for collective learning of such attempts to manage a mobile labor market.

The key to aligning the two functions within a corporation is the credible promise to the employees concerned of rewarding career opportunities—ones in which they can expect to be promoted over time to positions of greater authority/responsibility, more attractive work conditions, and better compensation. The ability of the firm to offer such rewards depends in turn on its growth. In effect, as it is successful, the firm shares the gains of its growth with its key employees in the form of career rewards. The corporation's sustained ability to deliver these career rewards to employees serves as a powerful tool for both retention and motivation.

What is the role of stock options in this process of aligning individual and collective incentives? For high-tech start-ups with no proven track record, stock options (and stock-based compensation more generally) serve as a recruitment/retention tool. The start-up must recruit and retain people who have career opportunities available in established companies, or who could choose to work for other start-ups. When the firm is very small, stock options can also motivate people since their individual efforts can have an effect on whether the options are ever worth anything (see Oyer and Schaefer, 2002). In a start-up, moreover, hierarchical position is not yet very important in determining rewards. Even then, insofar as stock options perform a motivation function, their distribution will have to be broad-based, covering all 'key' employees—and in a small start-up virtually all regular employees will be key. Otherwise employees without stock options would see themselves as working for the benefit of those with options or equity stakes, while at the same time they would be foregoing career opportunities with established companies.

As the firm grows larger, however, there tends to be a shift in the balance of the functions of stock options taken on their own toward retention, with the motivation

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<sup>56</sup>For an elaboration of our perspective on organizational learning and the academic sources on which it draws, see Lazonick and O'Sullivan (2000b).

function served increasingly by more attractive and remunerative career opportunities within the firm. The alignment of the retention and motivation functions can be maintained by making career rewards the main determinant of the allocation of stock options among employees, so that stock-based rewards are in effect ancillary to the motivation function performed by career opportunities. Given a broad-based stock option plan, a gradually rising stock price that reflects the success of the firm over time serves to keep the retention and motivation incentives aligned, but again only because the extent of one's gains from exercising stock options depends on one's career advancement package.

The New Economy boom in optical networking disrupted the alignment of the retention and motivation functions in the corporate incentive systems of the companies involved, with stock options playing an apparently important role as a mechanism of disruption. As we have seen, at Nortel, Lucent and Alcatel, it was through the acquisition of New Economy companies with an 'options' culture that stock option grants were imported into their compensation systems for the first time. Many longstanding employees of Old Economy companies who had previously been concerned with moving up and around the organization, with secure pension benefits at the end of the line, now started to be enticed to 'jump ship' to companies at which stock-based compensation appeared to offer a quicker and more lucrative path to success. This stock-based labor competition, and the mobility of labor that it encouraged, placed greater pressure on companies to boost their stock prices, while also leading them to counter threats of employee exit with offers of individualized remuneration packages that included more stock options. In spinning off its optical components division as Agere, Lucent even went so far as to engage in restructuring in order to offer its more highly mobile groups of employees a potentially more valuable stock than that of Lucent as a whole that would determine their stock-based compensation. Alcatel engaged in the same type of 'compensation engineering' when, in September 2000, it created a tracking stock for Alcatel Optronics. The result in the Old Economy companies was an *ad hoc* development of stock option programs—add-ons to the compensation system driven by a combination of the company's acquisition strategy and individual labor mobility rather than the needs of collective learning. As these companies sought to use their stock as a currency for accumulating innovative capability, it was their efforts to manage the highly mobile labor market, not to manage the internal learning processes, that shaped the ways in which they adopted stock options as a new element of the incentive system.

This is not to say that the stock-based mobility of labor during the peak of the boom had no disruptive influence on Cisco. It was perhaps to counter 'job hopping' that in fiscal 2000 Cisco lowered the proportion of options going to its five highest paid executives by 36% compared with the average of the previous two years, while raising by 25% the number of options distributed in the company as a whole. But, if so, Cisco was making adjustments to changing labor market conditions without having to transform the ways in which it recruited, retained, and motivated people. A systematic,

broad-based stock option plan has been integral to Cisco's history of growth. Indeed, as, in the boom, Cisco's stock price rose higher and faster than its Old Economy competitors, the loss of certain key people may have threatened the company less because they were going to work for competitors and more because, having grown very rich very fast by exercising options, these former employees no longer needed to work for anyone.

Even with access to company data and personnel, it will be difficult to quantify the impact of this introduction of *ad hoc* stock option plans on the accumulation of innovative capability by the Old Economy companies. Moreover, given the importance of innovative strategy as a determinant of the type of innovative structure required, it would probably be wrong to place too much emphasis on the role of stock options systems at the Old Economy companies in determining their success or failure in the accumulation of innovative capability. In particular, the failed acquisitions that Nortel and Lucent made in 2000 were probably more the result of bad strategic management, in part influenced by stock-based rewards that were highly skewed toward the top executives who were ultimately responsible for the strategic decisions, rather than bad organizational incentives related to the distribution of stock options among non-executive personnel.

### 6.3 *Financial commitment*

Did the use of stock as a combination and compensation currency promote or undermine access of companies to committed finance that could sustain innovation processes until they could generate returns? During the New Economy boom, which was subsequent to Lucent's spinoff from AT&T, none of the four companies that we have been examining went to the stock market for cash. In this, their behavior differed from a number of New Economy companies, some of them with unproven technologies, that raised unprecedented amounts of funds in IPOs and secondary offerings.

For example, in the optical networking industry, in 1999 and 2000, at the height of the New Economy boom, Ciena, which was founded in 1992 and went public in 1997, raised \$1.1 billion; Sycamore Networks, launched in 1998 by the founders of Cascade, with its IPO in 1999, raised \$1.2 billion; and Corvis, launched in 1999 by the founder of Ciena, with its IPO in 2000, \$1.1 billion through IPOs and secondary offerings (various company SEC filings). While Ciena had a proven technology, the other two did not. Even amidst the euphoria of the boom, no venture capitalist would have thrown this much money behind an untested start-up, even one whose entrepreneurs had proven track records. Was the speculative stock market rational in its allocation of capital within the optical networking industry in the New Economy boom? The answer is no. It was the speculative frenzy combined with astute financial engineering—not a reasoned assessment of the innovative potential of these companies—that made the stock market such a munificent source of cash for companies like Ciena, Corvis, and Sycamore.

In the decline, of course, things are much different. IPOs are difficult—in the USA there were 490 IPOs of significance in 1999, 385 in 2000, but only 81 in 2001 and 73 in

2002 (Ritter, 2003: 6)—and in general the stock market is not a source of cash either directly or as an inducement for the allocation of venture capital to start-ups. There are particular cases, such as those of Nortel and Lucent described earlier, in which, in the decline, the stock market has supplied cash to companies. It is doing so, however, at rock-bottom stock prices and with extensive dilution of shareholdings as these companies, shut out of the bond market and laying off valuable human assets in droves, desperately seek to stave off bankruptcy. Has the depressed stock market been rationally allocating capital in the optical networking industry? It depends on one's view of how damaged these companies are as a result of the necessity of restructuring as deeply and as rapidly as they have.

However irrational the stock market as an allocator of cash to innovative companies, the interesting question that this study raises is the rationality of the major optical networking companies in failing to take advantage of their high stock prices in the speculative boom to load up on cash, and thus make themselves less vulnerable to the bursting of the bubble. After all, US corporations had behaved this way in the speculative boom of the late 1920s (O'Sullivan, 2003), and, in more recent history, major Japanese corporations had sold massive amounts of stock in Japan's 'bubble economy' of the late 1980s (see, for example, Ide, 1998: 83–4; more generally, see Lazonick, 1999). Had it not been for this financial behavior, the adverse impacts on these corporations of the subsequent downturns—in the USA in the early 1930s and Japan in the early 1990s—would have been far more severe.

Why, then, in the New Economy boom, did strategic decision makers in the optical networking companies eschew the opportunity of selling stock to strengthen their cash balances? It would take a separate study to generate the evidence required to answer this question. Did the top managers of these companies think that the attempt to sell stock at speculative prices would have led to a fall in the price of the company's stock? A fall in the stock price would have made the company's stock less valuable as a combination and compensation currency for the accumulation of innovative capability. A fall in the stock price would have also reduced their own compensation, heavily dependent as it was on the gains from exercising stock options. Or perhaps they were concerned that a fall in the stock price could threaten them with loss of their positions of strategic control. Whatever the reason for this financial behavior, the fact is that during the New Economy boom the stock market was a source of cash for the senior executives of these companies, even if it was not a source of cash for the companies they controlled.

## **7. The stock market and innovative capability: some implications**

During the New Economy boom, the stock market was an extremely important economic institution. Quite apart from its influence on the accumulation of innovative

capability, in the New Economy boom the stock market delivered high returns on US household savings and, through taxes on the capital gains of stock trading, helped federal and local governments to transform budget deficits into surpluses. The stock market even served to maintain the strong value of the US dollar as foreign portfolio investment flowed into the US stock markets in search of high financial returns.

Yet ultimately, over a sustained period of time, high stock-market returns depend on the productive performance of the companies that issue that stock. This productive performance depends in turn on the innovative capability of corporations; their ability to generate higher quality, lower cost goods and services than had previously been available. To our knowledge, this paper represents the first systematic effort to elaborate an analytical framework for exploring the relation between the different functions of the stock market and the accumulation of innovative capability.

We have applied this analytical framework, moreover, to a high-technology industry that was central to the New Economy boom and that epitomizes how that boom has turned to bust. We have presented evidence that the current problems of Lucent and Nortel run deeper than the collapse in demand for their products because of an over-investment in capacity by their customers in the boom. They have been threatened with bankruptcy in the decline because of the way in which those in strategic control of these companies, with their focus on boosting stock prices, allocated resources during the boom. We have also argued that the problem with strategic decision making in the boom lay in the incentives, not the abilities, of senior executives, and that those incentives were driven by stock-price performance. If that stock-price performance had been primarily dependent on the innovative success of the corporation, one could make the argument that stock-based compensation had functioned as an incentive for strategic decision makers to allocate resources to investments that could result in innovation. If, however, as seems to have been the case, stock-price performance was primarily dependent on speculative trading activity, it created an incentive for those with strategic control who were positioned to reap significant stock-based rewards to make allocation decisions that could benefit themselves even if other participants in the corporation, particularly career personnel who eventually found themselves unemployed, ultimately had to pay the price.

If stock-based compensation is to serve as a 'long-term' incentive for strategic decision makers to allocate resources to innovation, there is a need to control the effects of stock-market speculation on business enterprises. The problem in the boom was, at best, a willingness of strategic managers to believe that if the stock market would enable innovative capability to be accumulated faster, the result would necessarily be better—as captured in the well-known slogan of John Roth, introduced after Nortel had acquired Bay Networks and apparently borrowed from Bill Gates, that a century-old organization of some 75 000 people could make a 'right-angle turn' (Laver, 1999). The problem was, at worst, a matter of the individual interests of some superseding the collective interests of many; speculation by its very nature results in winners and losers, and when positioning to be one rather than the other invades an

organization that depends on collective and cumulative learning to be successful, one should not expect that innovative outcomes will be the result.

Depending on how it is introduced and implemented, stock-based compensation may encourage such individualistic positioning. For companies such as Nortel, Lucent and Alcatel that had no experience with non-executive stock options coming into the boom, the extension of stock options to a broader group of people in the midst of a speculative frenzy was undoubtedly the worst of all possible worlds. The evidence suggests that in these companies, stock option grants were *ad hoc* means of managing individual mobility on the labor market; they had nothing to do with managing collective learning processes. In the face of such stock-price volatility, existence of a broad-based stock option system, deeply embedded in the reward structure of the organization, as was the case at Cisco, can help to constrain such individualistic positioning. Indeed, one could plausibly argue that a common concern among a broad base of employees with the performance of a company's stock price can serve as a powerful lever for the organizational integration that innovation requires. Even then, it is also possible that a speculative stock market will create a common incentive among participants in a broad-based stock option plan to acquiesce in corporate strategies that boost stock prices even if these strategies are not designed to generate higher quality, lower cost products.

Our study of the optical networking industry also raises doubts about the importance of the stock market as a source of cash for the accumulation of innovative capability. It has long been recognized that, as a general rule, the stock market was a relatively unimportant source of finance in the Old Economy. There were exceptions to this rule (O'Sullivan, 2003), and, as we have seen, there have been cases in which some New Economy companies in the optical networking industry were able to raise enormous sums through public stock issues. The most significant change in the stock market as a source of cash in the New Economy, however, derives from the pressure created for companies that rely on the use of stock as a combination and compensation currency to do stock repurchases. Even companies that paid no dividends found that, through repurchases, they became a source of cash to the stock market. At the same time, the increased use of stock as a combination and compensation currency in the New Economy meant that the stock market increasingly functioned as a source of cash for individuals who exercised their stock options, even if not for companies through the sale of their stock on the market. Currently, moreover, with the returns to household savings having collapsed along with the New Economy boom, there is an incipient political movement in the USA to have companies increase their dividend payments, with cash-rich Microsoft having already taken the symbolic step of paying the first dividend in its history (Lohr, 2003).

With the savings of US households so deeply invested in the stock market—itsself a phenomenon that coincided with the transition from the Old Economy to the New Economy in the USA (Lazonick and O'Sullivan, 2000a)—one has to ask the question of how over the long run returns to stock-based savings can be sustained. Ultimately, of

course, only so much value can be extracted from companies without new value being created; hence the importance of innovation not only for the particular companies concerned but for the sustainable prosperity of the economy as a whole. The relation between the creation and extraction of value is a big question—it is in essence what economics is (or should be) about. We should not expect easy answers. Our study of the optical networking industry, in all its detail, has provided evidence on the relation between the evolving stock market and innovative capability that is to a large extent unique in time and in place. At the same time, however, the study develops an analytical framework on the interaction of the stock market and the industrial corporation that, we believe, can be useful to a systematic program of comparative institutional and industrial research on an economic issue of major concern.

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