From Innovation to Financialization:
How Cisco Systems Became Focused on Its Stock Price and Lost Its Way

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NOTE: This version of the paper is for the discussants, Alain Rizk and Josh Whitford. A final conference version, with minor edits, will be available in the morning of December 6. There are three case study documents on optical networking, back haul, and data centers associated with this paper that are being made available to the discussants but as works in progress may not be posted on the conference website.

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I. Innovation or financialization?

Over the past three decades, the information and communication technology (ICT) industries have undergone enormous waves of technological change. In the 1980s personal computers transformed information technology as they became more powerful, user-friendly, and ubiquitous. In the 1990s the Internet transformed communication technology by enabling all of these computers to "talk" with one another. Meanwhile, in the traditional realm of telephony, in the late 1990s fiber optics made voice communications faster and cheaper, while communication systems began to respond to the challenge of integrating voice, data, and video. Then in the 2000s, as it moved from 2G to 3G to 4G, mobile technology brought together information and communication technology in an increasingly device-driven system with a burgeoning array of applications ranging from tools to toys. Supporting these developments have been massive investments in communication infrastructures including wireline optical networks that span the globe and wireless radio base stations that extend to remote locations.

In this process of creative destruction, emanating from the United States, there was a fundamental change in the "business model" that characterized competitors in the ICT industries (Carpenter et al. 2003, Lazonick 2009). A number of "New Economy" companies, founded from the late 1960s on, such as Intel. Microsoft, Oracle, Cisco, Apple, and Google, became ICT giants while a number of once-powerful "Old Economy" companies such as Lucent Technologies (formerly part of AT&T Technologies), Nortel Networks (formerly Northern Telecom, based in Canada but with its main markets and much of its research in the United States), and Motorola failed to keep up. Meanwhile, as exemplified by the transformations of IBM and Hewlett-Packard, some major US companies that led the change from proprietary to open technological architectures in ICT made the transition from what Lazonick (2009) has called the "Old Economy business model" (OEBM) to the "New Economy business model" (NEBM), although in the case of these two particular companies IBM has sustained its successful transition while HP has hit on hard times.

Table 1 outlines the key characteristics of OEBM and NEBM in terms of strategy, finance, and organization – the three activities that are generic to any business model. With its specialized product markets, its vertically specialized value chains, its open systems technological architectures, and its cross-licensing of technology, NEBM has tended to focus far more on "development", i.e., the commercialization of known technologies, rather than "research", i.e., the discovery of new technologies. As Gordon Moore (1996, 171), the co-founder of Intel, put it from the perspective of the 1990s:

> Running with the ideas that big companies can only lope along with has come to be the acknowledged role of the spin-off, or start-up. Note, however, that it is important to distinguish here between exploitation and creation. It is often said that start-ups are better at creating new things. They are not; they are better at *exploiting* them. Successful start-ups almost always begin with an idea that has ripened in the research organization of a large company. Lose the large companies, or research organizations of large companies, and start-ups disappear.

Table 1. Strategy, Organization, and Finance of the Old Economy Business Model (OEBM) and the New Economy Business Model (NEBM)

	OEBM	*NEBM*
Strategy, product	Growth by building on internal capabilities; business expansion into new product markets based on related technologies; geographic expansion to access national product markets.	New firm entry into specialized markets; sale of branded components to system integrators; accumulation of new capabilities by acquiring young technology firms.
Strategy, process	Corporate R&D labs; development and patenting of proprietary technologies; vertical integration of the value chain, at home and abroad.	Cross-licensing of technology based on open systems; vertical specialization of the value chain; outsourcing and offshoring.
Finance	Venture finance from personal savings, family, and business associates; NYSE listing; payment of steady dividends; growth finance from retentions leveraged with bond issues.	Organized venture capital; initial public offering on NASDAQ; low or no dividends; growth finance from retentions plus stock as acquisition currency; stock repurchases to support stock price.
Organization	Secure employment: career with one company; salaried and hourly employees; unions; defined-benefit pensions; employer-funded medical insurance in employment and retirement.	Insecure employment: inter-firm mobility of labor; broad-based stock options; nonunion; defined-contribution pensions; employee bears greater burden of medical insurance.

Source: Lazonick 2009, 17.

At the same time, in its rise in the 1980s and 1990s, as shown for "finance" and "organization" in Table 1, NEBM relied heavily on the stock market to attract capital and labor away from Old Economy companies. The 1971 launch of the National Association of Security Dealers Automated Quotation System, or NASDAQ, created an electronic stock market that integrated trading on the previously fragmented over-the-counter markets, thus vastly increasing the liquidity of the market for companies with low capitalization and little if any profitability record. Catering especially to these types of companies, NASDAQ had much laxer listing requirements than the "Old Economy" New York Stock Exchange (NYSE). As a result, NASDAQ provided venture capitalists with the possibility of a much quicker "exit" from their investments in young companies through an initial public offering (IPO) than did NYSE.

Besides inducing financial backing for new-firm formation, NEBM also relied in part on the stock market. Especially in the 1980s, Old Economy companies such as IBM, HP, Motorola, and Texas Instruments offered the security of a career with one company to the types of professional, technical, and administrative employees that New Economy startups wanted to hire. To lure these employees away from secure Old Economy employment, the New Economy companies

offered employees stock options which could become very valuable if a company could do an IPO and if it could subsequently grow to capture a significant market share. Indeed in the dotcom mania of the late 1990s, an ICT company did not necessarily even have a commercial product to get listed on NASDAQ astronomical capitalization, thus making millionaires of many employees who had part of their remuneration in the form of stock options and other stock-based compensation.

Yet the Internet boom of the late 1990s was based on a very real technological revolution that has transformed all types of work, education, and play. The communication technology part of this revolution involved the most sophisticated technologies in ICT. In the Internet revolution, the United States held center stage, in large part because of government investment in computing and digital networking, including transistors and packet switching, for decades before the Internet was commercialized in 1993 (National Research Council 1999; Abbate 2000).

No company capitalized more on the Internet revolution than Cisco Systems. Founded in 1984 in the heart of Silicon Valley, Cisco grew from $70 million in sales and 254 employees in 1990, the year of its IPO, to $18.9 billion and 34,000 employees a decade later. Key to Cisco's growth from 1993 were, as we discuss in detail later, numerous acquisitions of other technology companies (Carpenter et al 2003). By the late Cisco 1990s could claim to have been the fastest growing company in US history (O'Reilly 1998). There is no ICT company that exemplified NEBM (as described in Table 1) more than Cisco did.

In the late 1990s some of the world's leading telecommunications equipment companies, dating back to the late 19th century, sought to emulate Cisco's growth through acquisition strategy in order to make the transition from voice to data communications. Foremost among them were Lucent Technologies and Nortel Networks. In 1999 Lucent Technologies, the descendant of Western Electric and Bell Labs, was the world's largest communication equipment company, with $38.3 billion in sales and 153,000 employees. Catching up with Lucent was Nortel Networks, an old-line Canadian company in which Western Electric had played an important role and which had become the world leader in digital switches primarily because of its provision of equipment to newer service providers in the United States such as Sprint and MCI

Within a decade after the speculative mania of the Internet boom had culminated in a spectacular crash of ICT stocks in 2001, both Lucent and Nortel had gone out of business as independent entities. In 2006 Lucent Technologies, a mere fragment of the former world leader, surrendered to the M&A designs of Alcatel, and became part of a French company, Alcatel-Lucent (Lazonick and March 2012).[1] In 2009 Nortel Networks, which less than a decade earlier had been the world leader in optical networking equipment, declared bankruptcy, and has since been sold off in pieces. A prime reason why Lucent and Nortel self-destructed in the 2000s was the attempt of these Old Economy companies to emulate Cisco's New Economy business model in the last half of the 1990s and into 2000s, during the Internet boom (Lazonick and March 2012).

[1] In 2011 Alcatel-Lucent recorded positive net income of $1.4 billion after losing $13.2 billion over the previous four years, subsequent to the merger with Lucent. But in 2012, it has been losing money again, and has recently been in talks with Goldman Sachs about a cash infusion.http://www.bloomberg.com/news/2012-11-22/alcatel-lucent-said-in-financing-talks-with-goldman-sachs.html

At the beginning of the 2000s Cisco was seen as the rising competitor in the communication infrastructure market, with unique capabilities in Voice over Internet Protocol (VoIP). In 2012 Cisco had 2.4 times the sales and 2.0 times the employees it had in 2000. Yet it failed to build on its accumulated capabilities to establish itself as a leader in the most sophisticated segments of communication technology. In the process the United States fell behind Europe and Asia in the provision of "carrier-class" communication infrastructure equipment. Instead of investing in these technologies, and the thousands of additional engineering employees who would be need to develop and utilize them, to become a world leader, from 2002 to 2012 Cisco spent $76.7 billion buying back its own stock, equivalent to 1.2 times its profits and 1.6 times its R&D spending over these 11 years.

Cisco was not alone among US companies in doing massive stock buybacks (Lazonick 2012). Over the decade 2001 to 2010 US corporations in the S&P 500 Index, which account for about 75 percent of the capitalization of all corporations in the United States, did about $3 trillion in buybacks, absorbing well over 50 percent of their net income, with dividends taking up another 40 percent. With $65.0 billion in buybacks over this decade, Cisco was #4 among US corporations, behind Exxon Mobil as #1 with $174.5 billion, Microsoft as #2 with $110 billion, and IBM as #3 with $89.2 billion. With S&P 500 companies spending over $400 billion on buybacks in 2011, Cisco did $6.9 billion in buybacks, placing it 11th. In 2012, Cisco cut back its repurchases to $4.8 billion, its third lowest amount since it started doing billion dollar repurchases in 2002.

Lazonick (2012) has argued that stock buybacks on this scale reflect the "financialization" of corporate resource allocation. By financialization, we mean the evaluation of the performance of a company by a financial measure such as earnings per share rather than by the goods and services that it produces, the customers it serves, and the people whom it employs. Since 1982 the US Securities and Exchange Commission has given corporations a "safe harbor" to engage in open market buybacks that for some of most highly traded companies can amount to $200,000 million or more per trading day. The prime purpose of stock buybacks is to boost a company's price. With the largest singe component of their remuneration coming from the exercise of stock options, prime beneficiaries of this legal stock-price manipulation are the very corporate executives who make these resource allocation decisions.

If asked, these executives will tell you that the reason why they buyback stock is because they think that the company's stock is undervalued. Stock buybacks are, according to this argument, an expression of confidence in the company's future stock-price performance. The big problem with this argument is that companies that repurchase their own stock hardly ever go back into the market at a later date to sell it at a higher price, an action that would reap returns for the corporate treasury and capitalize the confidence that the executives had shown in have done the repurchases. To do so would be to announce to the market that, in the executives' view, the company's stock price had reached its peak, and that, following the company's own example, now was a good time to get out of the stock. If, as financial economists have argued (Vermaelen 2005, ch. 3; Louis and White 2007), a CFO does buybacks to signal the market that they think the company's stock is undervalued, he or she does not want to send the opposite signal to the market by cashing in for the company if and when its stock price has risen.

At the same time, there is no doubt that stock buybacks are an important aid in inflating corporate executive pay, and thereby contributes to the concentration of income at the very top of the distribution (say, the top 0.1 percent) (Lazonick 2012). But is a manipulative distortion of the distribution of income the full extent of the damage that stock buybacks do? We think not. By influencing the corporate allocation of resources, large-scale stock buybacks may come at the expense of investment in innovation and hence the sustained profitability and even viability of the company. Within the firm, the money spent on buybacks could have been used to train and retain employees, to fund R&D, for capital expenditures, or to move into new product markets.

Of course, at any point in time, the companies doing these buybacks are also allocating resources to these other uses of funds, so the argument would have to be that, because of buybacks, the company is not doing *enough* training, R&D, CAPEX, or diversification. But, in a business world of rapid innovation and intense competition, how much is "enough"? In a high-technology industry such as communication equipment, new technological opportunities and new competition are constantly changing the funding requirements of remaining a world leader through innovation. To support the "financialization hypothesis" that buybacks undermine investment in innovation, one would have to show that innovative investments that a company could have made to remain in the forefront of innovation were in fact foregone.

In some cases, the deleterious impacts of large-scale buybacks on investment in innovative capability seem clear. In 2005-2007, following the success of its 2G Razr cellphone, Motorola did $8.0 billion in buybacks, just over 100 percent of its net income, and then failed to become a leader in 3G phones. After losing $4.3 billion from 2007 through 2009, Motorola spun off its wireless division as Motorola Mobility in 2010, which was then sold to Google in May 2012. As another example, the world leader in smartphones was the Canadian company, Research in Motion. But it has faltered recently after spending $3.0 billion on buybacks (1.3 times its R&D expenditures) in 2009 and 2010, at precisely the time at which competition based on "smart" technologies was becoming most intense.

In other cases, there is a surface plausibility that a preoccupation of corporate executives, manifested by buybacks, with boosting a company's stock price sapped a company's innovative potential. For example, coming from information technology, the U.S. company best positioned in the 2000s to integrate with communication technology was Microsoft, the world's dominant computer software company. Instead Microsoft remained a belated imitator of other more successful companies. From 2002 through 2011, Microsoft spent $115.5 billion repurchasing its stock, equivalent to 100% of its earnings and 1.6 times its R&D expenditures. Or as another example, Qualcomm remains a supplier of high-end chipsets for smartphones and reaps over one-third of its revenues ($5.7 billion of $15.0 billion in 2011) from its intellectual property. But, while buying back $9.0 billion of its stock since 2005, has not been an active participant in setting the global 3G and 4G standards that derive from its CDMA technology.

In sharp contrast, retaining all its earnings, Apple transformed itself from a troubled niche player at the beginning of the 2000s into the world's most profitable company by the end of the

decade.[2] Similarly, Google has mobilized its financial resources to build on its competitive success in one line of business to innovate in other lines, including, with its Android operating system, smartphones. The Swedish company, Ericsson, the world leader in communication equipment, does not do buybacks. Nor does the Chinese company, Huawei Technologies, which is nipping at Ericsson's heels. But then Huawei, an employee-owned company, is not listed on a stock market. In contrast, the one-time champion of mobile telephony, the Finnish company, Nokia, has a longstanding stock-option culture and for 2001-2010 is the fifth largest stock repurchaser in Europe, and has been in sharp decline.

In the absence of privileged access to the mindsets of top corporate executives in making major resource allocation decisions, the only way to do a serious test of the "financialization hypothesis" is to engage in essentially forensic research into, given the technologies, markets, and competitors that characterize its industry, what investments in innovation a particular company, on the basis of the opportunities available to it by its own technological and market trajectories, did or did not make. \ For this purpose, we have chosen to do a case study of Cisco Systems.

Cisco is a highly profitable company that over the past 11 years has been able to "afford" to spend an average of $7 billion per year buying back its stock (even though Cisco's stock price is about where it was in January 2002). As stated earlier, Cisco has more than doubled it revenues since 2000. The company's R&D expenditures remain substantial, but R&D as a percent of sales fell from 19.2 in the period 1997-2003 to 13.2 in the period 2004-2012. In 2012 R&D as a percent of sales was 11.9, the company's lowest rate since 1996. In 2000 Cisco was poised to become the most sophisticated communication technology company in the world. That it clearly has not done. The questions that we explore in the detailed research that follows is whether, how, and to what extent Cisco's financial behavior as manifested by its addiction to stock buybacks has influenced its innovative strategy and performance.

[2] W. Lazonick "Apple's Business Model: A Foundation for Sustainable Prosperity?" Presentation to a Workshop on Apple Inc.'s Business Model, University of London, April 25, 2012; See also the chapter on Apple in the expanded version of Mazzucato, *Entrepreneurial State*, in progress.

II. Cisco Systems: From Innovation to Financialization?

Cisco Systems emerged in the last half of the 1980s out of the convergence of the previous distinct industries engaged in information technology and communication technology. The origins of this convergence go back to the early 1970s when, at Xerox PARC, the Palo Alto-based research arm of the Old Economy copier company, Robert Metcalfe led a team that developed Ethernet, a technology that enabled computers to communicate with one another (Hiltzik 2000, ch. 13). When Xerox declined to commercialize this technology, Metcalfe sought to do so by co-founding 3Com – standing for "computer, communication, and compatibility" – in 1979. With the widespread adoption of the IBM PC from 1982, 3Com was well positioned to be a leader in providing the hardware and software for local area networks (LANs).

After 3Com acquired the Silicon Valley company Bridge Communications in 1987, it became the largest supplier of LAN equipment, followed by Novell, based in Provo, Utah (Mulqueen 1989a). By this time, however, business, government, and nonprofit organizations that had installed LANs in geographically dispersed locations wanted bridges or routers that would link their LANs with wide area networks (WANs). The company that, by the beginning of the 1990s, was most successful in developing this internetworking technology, mainly because it wrote software for all possible protocols, was Cisco Systems.

In 1984 Leonard Bosack and Sandy Lerner, a husband and wife team, founded cisco,[3] and initially ran it from their living room. While working in computing in different parts of Stanford University, Bosack and Lerner had been involved in the development of the university's LANs and then had taken up the challenge of internetworking them. At the end of 1987, Cisco received an infusion of $2.5 million in venture funds from Sequoia Capital (Bellinger 1989; Mulqueen 1989b; Watson 1988). Yet with $10 million in revenues in fiscal 1988, venture finance was probably the least important of Sequoia's contributions to the growth of the firm. The case of Cisco exemplifies the *nonfinancial* role of Silicon Valley venture capitalists in developing a promising start-up into a going concern. The Sequoia partner most actively involved with the young company was Donald Valentine, one of the pioneering Silicon Valley venture capitalists, who became a member of Cisco's board of directors. During 1988 Valentine directed the hiring of professional managers at Cisco, including John Morgridge, a veteran computer industry executive, as Cisco president and CEO.

Morgridge stepped down as CEO in 1995 but remained Cisco's Chairman of the Board until 2006. Valentine also remained a member of the board until 2006. Beyond the initial professionalization of the company in the late 1980s, Morgridge and Valentine oversaw the phenomenal growth of Cisco from less than $28 million in sales in the year ending July 1989 to over $22 billion in sales in the year ending July 2001. The ways in which Cisco financed this growth as a publicly traded company exemplify NEBM.

[3] The company's name, short for San Francisco, was actually spelt cisco, with a lower-case initial "c" until it went public in 1990.

Cisco's IPO in February 1990 netted the company $48 million that was used for working capital and cash reserves. Funds from operations easily covered the company's capital expenditures, not only in 1990 but also for every subsequent year. During its 23 years of existence as a public company, Cisco has collected $28.8 billion from its employees as they have exercised their stock options, a result of the fact that the company uses it stock as a compensation currency. But Cisco has never done another public stock offering. From 1993 to 2003, however, Cisco used its stock as a combination currency, doing 81 acquisitions for $38.1 billion, 98 percent of which was paid in stock (Carpenter et al. 2003).

In 1993, Cisco was still a one-product company that made only routers when one of its big customers, Boeing, said that it was going to develop local area networks that would use lower-cost switches rather than routers. It was about to make an order of $10 million with switch supplier Crescendo (Paulson 2001, 52). Another of Cisco's customers, Ford, also told it that it was considering the fast Ethernet LAN technology available from Crescendo (Brueller and Capron 2010, 6). Rather than take on the risk of merging with Synoptics, a similar-sized hub and switch supplier based in Santa Clara,[4] Cisco decided to experiment with the acquisition route. It is suggested that John Chambers convinced the board of Cisco to prefer the Crescendo option as, in addition to disliking the idea of a merger of equals, "he also needed some type of project that would enable him to politically and managerially earn his stripes on his own merits within Cisco" (Paulson 2001, 51). On Chamber's recommendation, Cisco thus chose to pay $95 million for Crescendo, then a loss-making switch maker with $10 million in revenues. At the time of acquisition, the price was considered exorbitant but the bet paid off for Cisco, as demand for corporate switching gear soared and sales reached $500 million within eighteen months, with annual sales of $2.8 billion by 1998, five years after the acquisition (Rifkin 1997). Crescendo's founder, Mario Mazzola, not only went on to become Cisco's Chief Development Officer, but also has had a significant role to play in Cisco's strategy of technological "spin-ins" developed in the late 2000s.

The Crescendo acquisition has been described not only as Cisco's most successful acquisition financially but also as "the genesis of Cisco's acquisition strategy" (Brueller and Capron 2010, 6). It established a pattern for future acquisitions throughout the 1990s of small start-ups with products that could immediately be leveraged by Cisco's high-performance distribution network. The Crescendo acquisition also introduced what was called the "Mario Rule" as its CEO had told Chambers he would not be acquired only to find his former employees fired following the deal. As a condition of the acquisition, the Mario Rule stated that no employees from Crescendo could be laid off or significantly reassigned without the joint approval of both CEOs (Mazzola and Chambers) (Paulson 2001, 53; Young 2001, 62; Slater 2003, 217-218). Finally the Crescendo acquisition also created a preference at Cisco for acquisitions that were located in Silicon Valley, although over time the company would add two more areas: the Research Triangle (near Raleigh, NC) and the Route 128 corridor (near Boston MA) (Paulson 2001, 123-124; Rifkin, 1997).

Cisco's subsequent domination of the router and switch markets has meant that there are often comparisons made to the decline of industry standard bearers such as DEC and Wang in previous

[4] Synoptics merged with Wellfleet Communications in October 1994 to form Bay Networks, later acquired by Nortel Networks as part of its "right-angle turn" that CEO, John Roth, wanted to implement to turn the 'telecom' company into an 'internet' company.

decades. When such doubts arise concerning the speed of change in the network industry, Cisco regularly points out that it overcame the threat from switching and went on to become market leader. When asked if Cisco is lacking clarity in its strategy, CEO John Chambers replies simply "we let our customers decide" (O'Reilly 1998, 2).[5]

The success of the Crescendo acquisition led Cisco to adopt such practices to a greater degree and at a faster pace than had previously been considered possible in terms of corporate growth. The phenomenon grew to such an extent that it was given its own acronym of A&D for "acquisition and development", as an alternative to R&D. In 1999 alone, Cisco acquired 18 companies at a cost of over $14.5 billion (almost entirely paid with stock) and 60 acquisitions were made overall during the seven-year period from 1993 to 2000 (Table 2). In addition to expanding and upgrading its product ranges in its routing and switching markets, Cisco also began to use such acquisitions to enter new businesses, such as the optical networking industry from 1996.

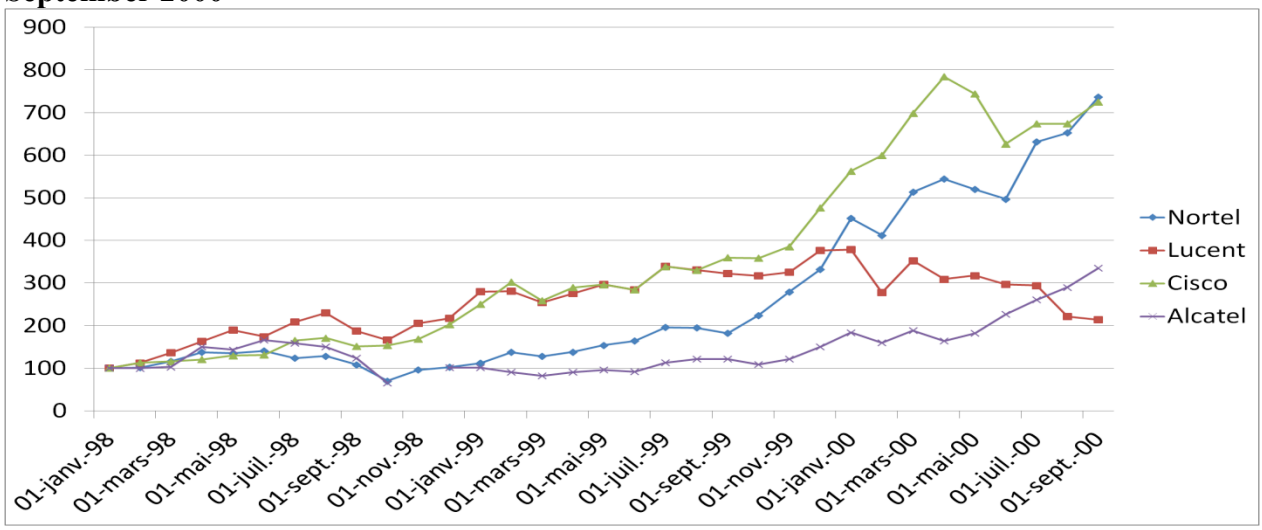
Table 2: Cisco's acquisitions, value and number, 1993-2000.

	1993	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***
Number	1	3	4	7	6	9	18	12
Value ($m)	95	414	467	4714	569	1,094	14,597	10,595
% stock	100	71	100	96	70	87	99.8	99.9

Source: Compiled from Cisco Press Releases, 1993-2000

During this period, Cisco became momentarily the most valuable company in the world, with a market capitalization of $541 billion in March 2000 (Figure 1). Its move into carrier class equipment meant that incumbent equipment suppliers, Alcatel, Lucent and Nortel were forced to revise their strategies for the development of innovative capabilities (Carpenter et al, 2003).

Figure 1: Evolution of market capitalization: Alcatel, Cisco, Nortel, Lucent, January 1998-September 2000



Source: www.yahoo.finance.com, Index = January 1998

[5] *Cisco Systems: the acquisition of technology is the acquisition of people',* Graduate School of Business, Stanford University Case Study by Charles O'Reilly, 1998, 2.

Cisco's shareholders and industry analysts were particularly attracted to the company's pioneering of a "virtual" supply chain within which lower-margin manufacturing activities are subcontracted and the firm concentrates on research, product development, service, distribution and marketing. The limits of this model began to appear, however, as Cisco moved into optical networking during the Internet boom. Optical networking products are targeted at telecommunications service providers, rather than enterprise customers, Cisco's traditional market segment. They are more technologically sophisticated products than routers and switches and, therefore, more difficult to manufacture. Prior to their installation into a new or existing telecommunications network, a rigorous testing phase is needed. The tests to which the product is subjected may also be adapted to take into account certain specifications of the intended use of the product and the manpower needed to carry out these tests must therefore possess a high level of both technological and reasoning skills.

In June 2000, Cisco thus made its first major investment in a manufacturing plant to develop in-house expertise in the more complex systems integration capabilities required by carrier-class optical networks as distinct from LAN data communications networks. Cisco chose to locate this plant in Salem, New Hampshire, just fifteen miles from Lucent's major systems integration facility in North Andover, Massachusetts, and proceeded to hire employees from Lucent, including the Cisco plant's top managers and engineers. Nortel also located a systems integration facility in the region to gain access to the regional skill base and skill-formation system that the Lucent plant, going back to its origins as a Western Electric facility in the 1950s, had played a major role in creating (Lazonick et al. 2002).[6]

In 2001, however, the bubble burst in the communications infrastructure market as it had done a year previously in the dotcom sector. In fiscal 2001 Cisco reported its first loss of slightly over $1.01 billion, caused by an excess inventory charge of a $2.5 billion for the three months ending April 30, 2001. This charge represented the largest inventory write-off in business history up to that date. The inventory build-up occurred because of a strategic decision taken by Cisco at the height of the boom in summer 2000 when, along with other optical networking companies, it was experiencing severe shortages of components. To eliminate what it estimated had cost it 10 percent in sales, Cisco decided to enter into agreements with suppliers that committed it to buying specific quantities of components. It also committed to help suppliers accumulate stock by offering them $600 million in interest-free loans. The company had not counted on the market slowdown[7] and "failed to plan for anything but growth" (Sidhu 2010, 67).

As demand for enterprise networking did not decline to the extent that service provider networking did, it appears that, at this point, Cisco began to question the wisdom of becoming a more sophisticated technology company by moving into carrier-class equipment. As a result of the downturn in the early 2000s, Cisco announced plans to lay off 500 people and abandoned the New Hampshire plant. CEO Chambers described fiscal 2002 as "the most difficult environment

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[6] "'Grow Your Own' in the New Economy?: Skill-Formation Challenges in the New England Optical Networking Industry," co-authored with Michael Fiddy and Steven Quimby, in Robert Forrant and Jean Pyle, eds., Globalization, Universities, and Issues of Sustainable Human Development, Elgar Publishing, 2002: 233-259.

[7] Phil Harvey, 2001, 'Cisco's Inventory Woes Mount', *Light Reading,* April 16.

Cisco Systems has ever faced".[8] The company's stock price collapsed to about 15 percent of its March 2000 peak, and in September 2001 (Q1 of fiscal 2002) it started systematically buying back its stock. Since that time, Cisco has become a regular re-purchaser of its own stock, with buybacks actually accounting for more than 200 percent of net income in 2003 (Figure 2). Between 2002 and 2012, Cisco repurchased $76.731 billion of its own shares.

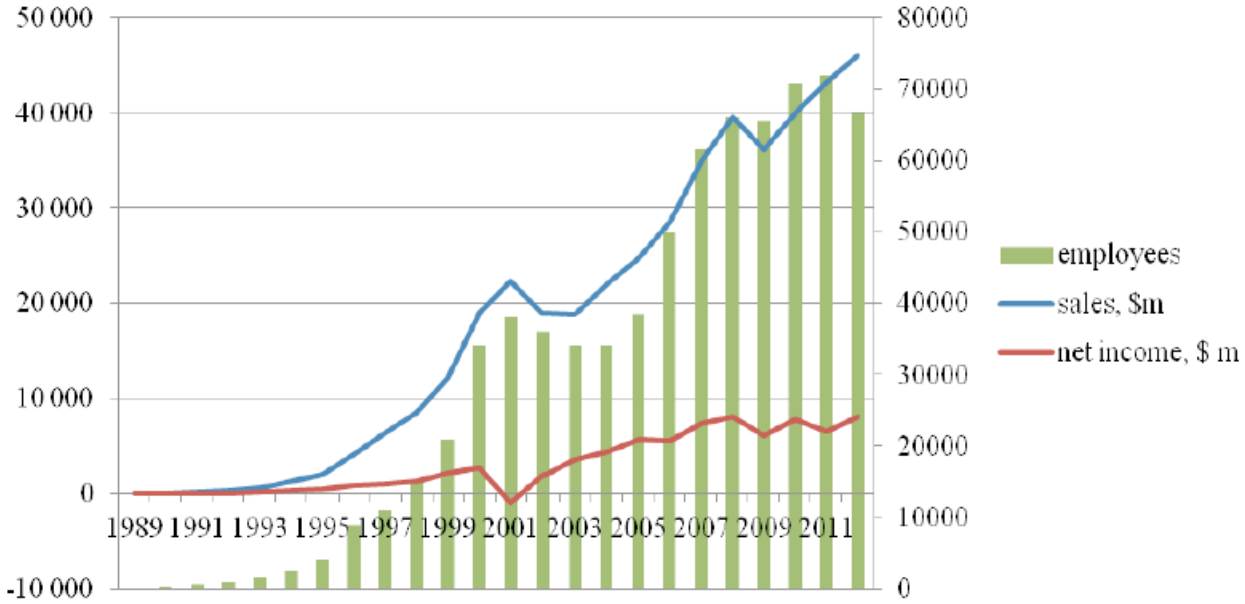
Figure 2: Cisco's buybacks , 1989-2012

Source: Cisco SEC 10-K Filings

Despite its $2.5 billion inventory difficulties in 2001, it is difficult to describe Cisco as anything other than a successful company (Figure 3). Its revenues have grown steadily since its formation and its unbridled growth throughout the 1990s qualified it as the world's fastest growing company. For fiscal 2012, which for Cisco ended in July 2012, revenues were over $46 billion, generating a net income of over $8 billion. Despite revenue growth of over 6.5 percent and net income growth of almost 24 percent, employee numbers fell in 2012 with the loss of over 5,000 jobs, representing over 7 percent of Cisco's workforce.

[8] Cisco Annual Report 2002: 2.

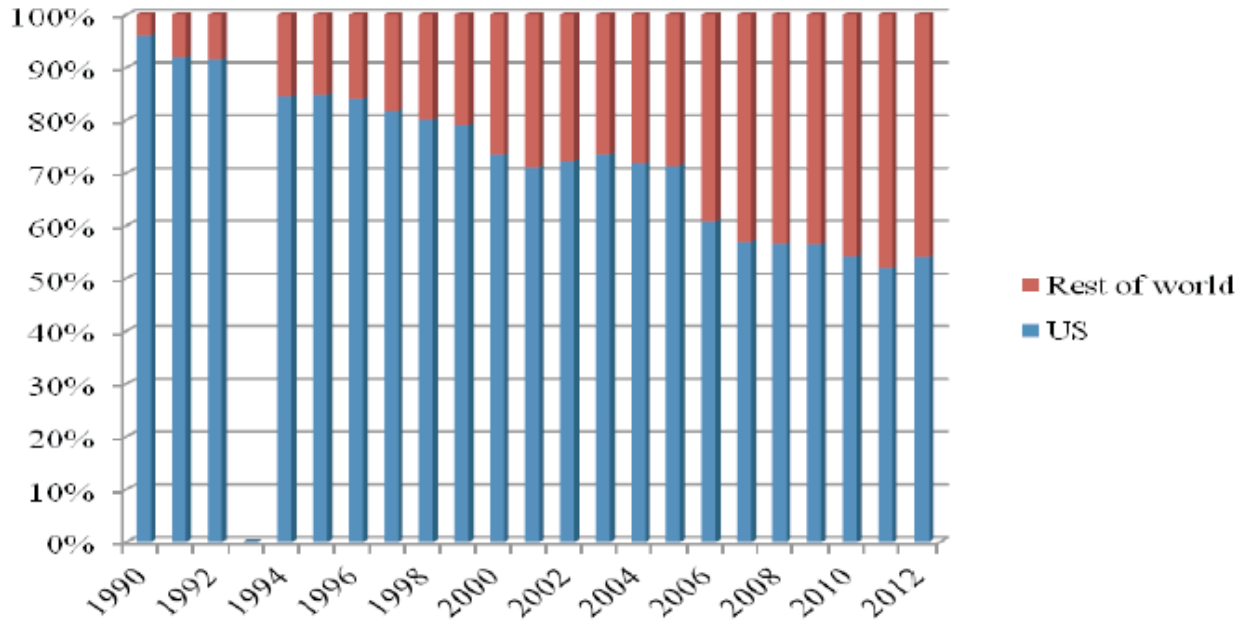
Figure 3: Cisco's sales ($m), net income ($m) and employees, 1989-2012



Source: Cisco SEC 10-K Filings

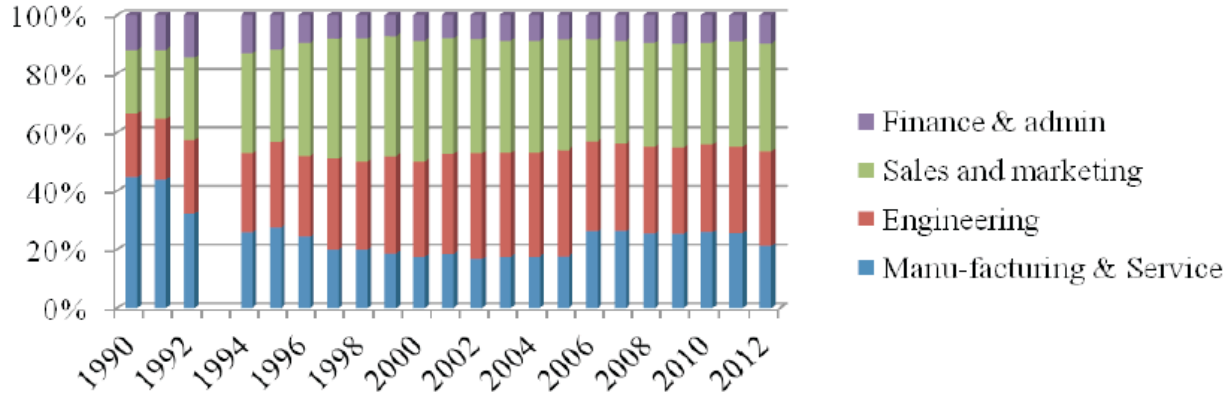
The company's workforce has been becoming more internationalized (Figure 4) and, following a decline in the early years, has remained fairly evenly divided between engineering, manufacturing and services and sales, marketing, finance and administration (Figure 5).

Figure 4: Breakdown of Cisco's employees: US v non-US, 1990-2012



Source: Cisco SEC 10-K Filings

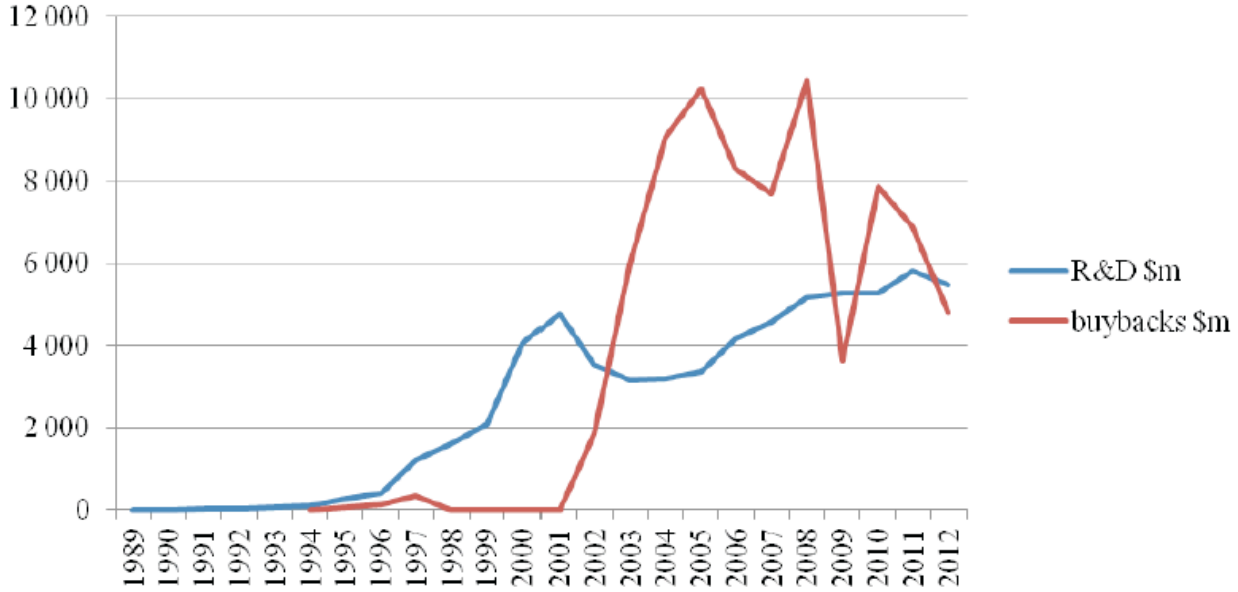
Figure 5: Breakdown of Cisco's employees by function, 1990-2012



Source: Cisco SEC 10-K Filings

While spending over $76 billion on buying its own shares since 2002, Cisco continued to increase its spending on research and development (Figure 6). From 2002 to 2009, however, spending on stock buybacks was significantly higher than R&D investment R&D spending was again surpassed by share buyback amounts in 2010 and 2011.

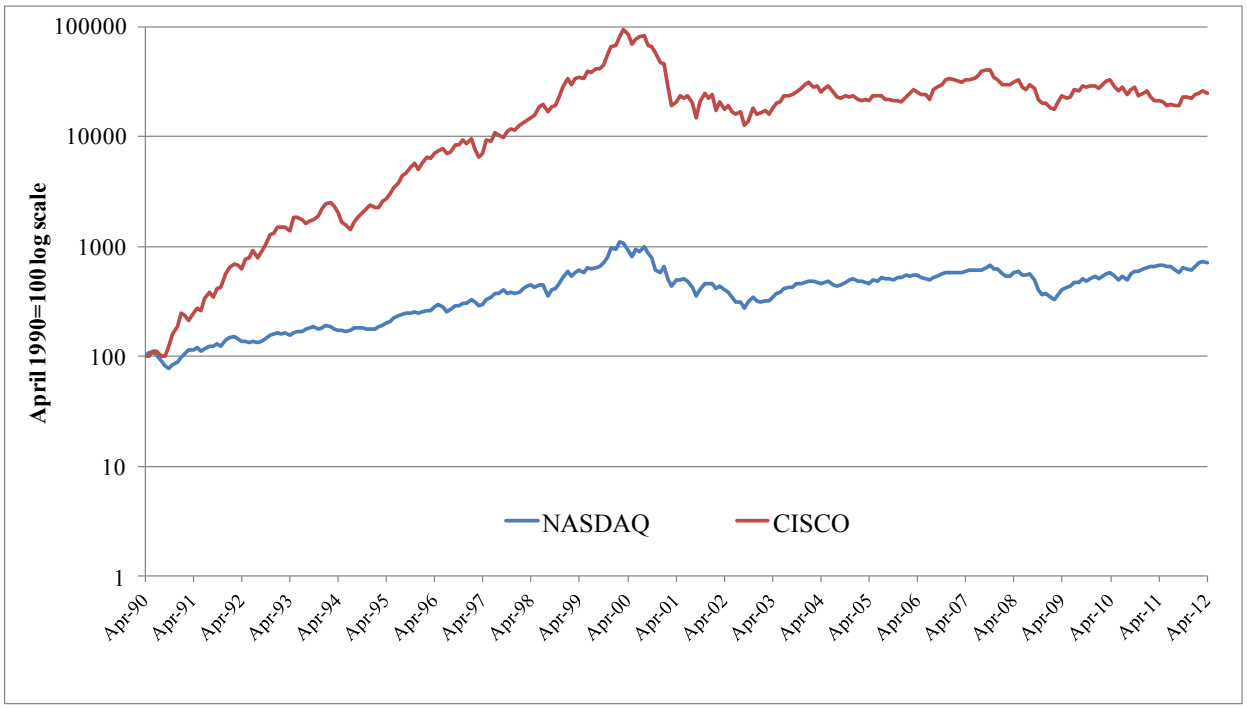
Figure 6: Cisco's spending on R&D and stock buybacks, 1990-2012



Source: Cisco SEC 10-K Filings

The introduction of a systematic stock buyback practice at Cisco coincides with the period, in 2001, when Cisco's stock had fallen dramatically from its previous high in 2000. Since then, the performance of Cisco's stock has been stagnant, yet somewhat volatile, in line with the NASDAQ Composite Index (Figure 7), an index it dramatically outperformed in the 1990s, during its rapid growth phase in a rapidly growing, but ultimately speculative market-place.

Figure 7: Stock-price movements, NASDAQ Composite Index and Cisco April 1990-April 2012



Source: Cisco SEC 10-K Filings

Cisco's stock price matters to the compensation of most of its employees. As is characteristic of NEBM, Cisco grants stock option awards to virtually all of its employees. While through reporting to the SEC in the company's proxy statements, we know the actual gains from exercising stock options of the CEO and four other highest paid in executives in any year. In addition, we have devised a way to calculate the average gains from exercising stock options in any year across all Cisco employees, not including the gains of the top five executives reported in the proxy statements (Lazonick 2009, 61-66). Table 3 shows these gains from exercising stock options for the top five and the rest of Cisco employees from 1995 through 2012. While especially over the past decade the average gains of the top five are typically several hundreds times larger than those of the average employee, the gains to Cisco's employees in general give them a stake in seeing boosts in the company's stock price. Notwithstanding Cisco's use of buybacks over the past decade to manipulate its stock price, however, the gains of Cisco's employees from exercising stock options have not approached those that were made in the last half of the 1990s through fiscal 2001, when a combination of innovation and speculation, rather than manipulation, drove the company's stock-price gains. From 1992 through 2011, as an executive at Cisco, current CEO John Chambers has received $662.2 million, or an average of $33.1 per year, Of this amount, 90.8 percent has come from the gains from exercising stock options.

Table 3. Cisco Systems, average gains from exercising stock options, top five executives and other employees, 1995-2012

	Average gains of top five, $	Average gains of other employees, $	Number of employees	Ratio of gains for top five to other employees
1995	4,065,000	50,894	4,086	80
1996	15,790,000	93,399	8,782	169
1997	3,124,000	85,159	11,000	37
1998	5,972,000	92,947	15,000	64
1999	60,586,000	193,476	21,000	313
2000	51,302,000	290,870	34,000	176
2001	11,884,000	105,865	38,000	112
2002	805,000	13,596	36,000	59
2003	1,291,000	8,917	34,000	145
2004	14,207,000	32,804	34,000	433
2005	15,804,000	24,432	38,413	647
2006	17,614,000	25,487	49,926	691
2007	22,517,000	73,004	61,535	308
2008	3,918,000	12,533	66,129	313
2009	0	2,153	65,550	0
2010	7,530,000	12,975	70,700	580
2011	15,000	4,154	71,825	4
2012	2,523,000	4,349	66,639	580

Source: Cisco Systems SEC proxy statement filings for top five data and 10-K filings for average employee data

This stock-option culture gives a broad range of Cisco employees, and not just its top executives, an interest in boosting the company's stock price. In an e-mail to Cisco employees on April 5, 2011, just a week before announcing that it would shutter its Flip video camera division, Chambers admitted that the company had "lost its way".[9] After "disappointing the market" for two quarters, Chambers told employees, "we have lost the accountability that has been the hallmark of our ability to execute consistently for our customers and our shareholders".[10]

In the company losing its way, we ask, what was the role if any of Cisco's expenditure of $76.7 billion on stock buybacks since 2002? Comparing the 1990s with the 2000s and beyond, has Cisco gone from innovation to financialization? In our view, the only way to answer these questions is through in-depth case studies of Cisco's strategy, capabilities, and investment behavior in key lines of business over the past 20 years. In this paper, we explore the possible impact of financialization on innovation in three key areas: optical networking, mobile networks, and data centers. Given our lack of access to Cisco to seek answers to these questions, our research relies mainly on the use of publicly available sources.[11]

[9] http://www.pcpro.co.uk/news/enterprise/366574/cisco-boss-we-have-lost-credibility, accessed December 2, 2012.

[10] Karen Tillman, "Message from John Chambers: Where Cisco is Taking the Network", http://blogs.cisco.com/news/message-from-john-chambers-where-cisco-is-taking-the-network/, accessed December 2, 2012.

[11] The authors are involved in the development of an initiative to develop "e-ris" or "Electronic Resources for Industry Studies" which promotes a methodological approach based on publicly available sources in order to advance insightful and detailed research on important research questions on company practices without necessarily obtaining the co-operation of the company in question. The initiative is hosted the website of theAIRnet, an Academic-Industry Research organization co-founded by the e-ris project directors. Full-scale studies of particular

Tables 4a and 4b show the evolution of Cisco by business segments from 1998 through 2012. In 2012, Cisco's traditional businesses of routing and switching continue to account for over 63% of its turnover. While both businesses continued to grow in absolute terms, their rate of growth fell quite dramatically. Revenues from routers actually dropped by almost 22% in 2009 but recovered in 2010 to grow by over 17%. 2011 and 2012 growth rates, however, were only 4.8% and 2% percent respectively. Meanwhile, the switches business – representing over 40% of Cisco's revenues – only grew by 0.4% in 2011 and 2.75% in 2012.

Table 4a. Cisco Systems Business Segment Sales ($US million)

Year	Routing	Switch	Access	Adv Tech	Collab oration	Service Prov Video	Wireless	Security	Data Centers	New Product	Other
1998	3,856	3,613	630								741
1999	5,196	5,167	1,127								124
2000	7,611	7,509	2,396								892
2001	7,095	9,141	1,869								1,454
2002	5,487	7,651		1,556							975
2003	4,859	7,721		2,004							981
2004	5,406	8,838		3,530							776
2005	5,498	9,950		4,021							1,384
2006	6,005	10,833		5,609							1,470
2007	7,064	12,432		7,926							2,040
2008	7,940	13,538		9,446							2,175
2009	6,521	11,923								9,859	828
2010	7,868	14,074			2,981	3,294	1,134	1,302	196		1,571
2011	8,264	14,130			4,013	3,483	1,427	1,200	694		1,315
2012	8,425	14,531			4,139	3,858	1,699	1,349	1,298		1,027

Table 4b. Cisco Systems Business Segment Sales (percent of total)

Year	Routing	Switch	Access	Adv Tech	Collab oration	Service Prov Video	Wireless	Security	Data Centers	New Product	Other
1998	43.6	40.9	7.1								8.4
1999	44.7	44.5	9.7								1.1
2000	41.3	40.8	13.0								4.8
2001	36.3	46.7	9.6								7.4
2002	35.0	48.8		9.9							6.2
2003	31.2	49.6		12.9							6.3
2004	29.1	47.6		19.0							4.2
2005	26.4	47.7		19.3							6.6
2006	25.1	45.3		23.5							6.1
2007	24.0	42.2		26.9							6.9
2008	24.0	40.9		28.5							6.6
2009	22.4	40.9								33.8	2.8
2010	24.3	43.4			9.2	10.2	3.5	4.0	0.6		4.8
2011	23.9	40.9			11.6	10.1	4.1	3.5	2.0		3.8
2012	23.2	40.0			11.4	10.6	4.7	3.7	3.6		2.8

Source: Cisco SEC 10-K filings

industrial sectors undertaken by theAIRnet members will make use of e-ris while also contributing to its development as a research tool.

Cisco's "advanced technology" segment was split into six different reporting segments in 2010. The two most significant segments are the collaboration and service provider video segments representing 11.4% and 10.6% of Cisco's turnover respectively in 2012. Wireless sales had grown to represent 4.7%. The security segment remained less important at 3.7% of revenues while the data centre segment grew from 0.6% of revenues to 3.6% of revenues from 2010 to 2011. The share of the "other segment", which includes optical networking, fell from 4.8% of revenues to 2.8% in the same period.

The technological areas – optical networking, mobile networks and data centers – chosen for in-depth analysis cover what are generally considered to be among the key technologies that will drive future generations of communications networks. Optical netwtorking represents Cisco's first major move into the service provider arena and the consequences of Cisco's challenge in this area proved very significant for the North American incumbents, Lucent and Nortel, both of whom attempted unsuccessfully to adopt aspects of Cisco's NEBM (Carpenter et al, 2003). While Cisco appeared to have almost entirely withdrawn from this segment, it continues to seek out profitable segments that it can dominate in the wireless space. As acquiring mobile capabilities appears to be an issue for a significant number of "new economy" firms such as Facebook and Google, not to mention Microsoft, it is clearly a diversification where proven recipes from other ICT businesses will be guaranteed to succeed. Finally, Cisco's foray into the data centre business is an area where Cisco's existing strengths in the enterprise market can conceivably be leveraged. It provides us with a "control" case that may illustrate the conditions under which Cisco's diversifications bear fruit.

These three segments are also still emerging technologies where much remains uncertain about the technological choices of different actors in the supply chains concerned, the standards that will dominate and the competitors that will gain and lose market share. For carrying out our analysis of the strategic, organizational, and financial conditions that support or undermine investment in these technological capabilities, we employ "the theory of innovative enterprise (Lazonick and O'Sullivan, 2000; Lazonick 2010).

While such qualitative research may not generate "proof" to support or contradict the financialization hypothesis, it is as present the only viable way to examine in a systematic way Cisco's real-world investment decisions and their long-run impacts on the company's innovative capabilities. For the purposes of clarity, only a summary of each case study will be presented in the main body of the paper, with the detailed case studies of the three technological areas being included in the appendices.

III Cisco's Withdrawal from Optical Networking

Cisco entered the optical networking segment at a time when the dynamics of the bubble were beginning to drive strategic thinking in the industry overall. In 2000, some analysts were predicting a tenfold growth rate for Cisco in the segment. The global optical transport sector alone was being forecast by other specialized industry research firms to grow from a size of $23 billion in 2000 to over $57 billion by 2005 (Carpenter, Lazonick et al. 2003).

Between 1996 and 2001, Cisco thus made eleven acquisitions in the optical networking space, at a total cost of over $16 billion. This 'investment' however was made in Cisco shares which, themselves, were rapidly inflating in value due to the speculative boom. The more technological capabilities that Cisco was able to acquire in this highly-promising area, the more its share price benefited. Apart from one significantly successful product development in the metro optical segment, the ONS 15454, Cisco did not manage to develop its presence significantly in the optical networking area overall.

Cisco's successful acquisition, Cerent, cost it $6.9 billion in 1999 but helped the company to increase its market share in the North American optical transport market from below one to 10% by the end of the following year, generating annual revenues of $500 million. None of the other ten acquisitions could be said to be successful however. StrataCom, which cost $4.7 billion in 1996, brought Cisco capabilities in the area of ATM – a non-IP technology – but these proved difficult to leverage due, in part, to integration difficulties with the 1,400-strong StrataCom workforce and marketplace confusion over the positioning of its products. The acquisition of three other optical firms, Pirelli Optical Systems for $2.2 billion, Monterey Networks for $500 million and Qeyton Systems for $800 million are generally considered to be failures also as the company did not pursue development of the products acquired and closed the plants acquired. The five other optical acquisitions made by Cisco during this time brought certain technological capabilities to the firm that were integrated into existing product lines but did not, overall, contribute to a change in Cisco's offering in the optical networking segment significant enough to increase its market share beyond what it had obtained from Cerent's SONET multiplexer.

One drawback common to all the acquisitions in the optical network area was Cisco's on-going difficulty in engaging with the service providers as successfully as it had been able to do so with its enterprise clients. Cisco's preference for revolutionary change in networks, driven by the flexible, but not entirely reliable, IP approach to data networking clashed head-on with the traditional circuit-driven approach of telecommunications providers who were concerned, above all, with the reliability that defines carrier-class equipment. In addition, incumbent telcos and larger service providers needed to integrate new equipment with their legacy systems. Those service providers attracted by Cisco's promise of a 'big bang' were generally new upstarts who perished in the post-boom period.

In the 2000s, Cisco continued to pay lip service to the importance of the optical networking segment and identified it in 2004 as one of its six advanced-technology areas with the potential to become a billion-dollar business. The company was no longer making acquisitions in the segment, however. Despite making 68 acquisitions in the decade, only a part of the Scientific Atlantic acquisition was linked to optical networking technology. Optical-related patent filings

plunged from over 500 in 2005 to virtually none by 2011 and the optical business was actually moved within Cisco's organizational chart to become part of "other business" in 2007. Employees were moved from the sites of optical plants to other areas of activity and key optical staff, such as Cerent founder, Ajaib Bhadare, left the company in 2007.

In the first decade of the 2000s, however, other new entrants have managed to accumulate the capabilities necessary to gain market share in the optical networking segment. The Chinese equipment manufacturers and, in particular, Huawei Technologies, have proven it is possible to move into this area and compete with strongly entrenched incumbents such as Alcatel-Lucent. Huawei has built on its strong presence in Asia and its emerging share in Africa, Russia and Europe to develop its optical business, at a time when demand in North America was particularly low. It has also gradually built up complete and cutting-edge capabilities in transport and metro optical networking systems and, in 2009, overtook Alcatel-Lucent to claim the position of global market-leader in optical networking systems.

Despite the slow-down that hit their main market following the period of over-investment at the height of the boom, North American equipment suppliers focused on the optical networking segment have mainly managed to continue to develop their business. In 2010, for example, Ciena, acquired the optical networking part of Nortel's business after its demise for $244 million in cash. Another more recent start-up, Infinera, has been developing its revolutionary photonic integrated circuit (PIC) technology as a platform for optical transport and switching. While not yet profitable, the company insists its manufacturing capabilities will give it the technological edge necessary to gain significant market share in the optical-dominated networks of the future.

Cisco re-entered the optical networking race in May 2010 with the acquisition of CoreOptics for $999 million and a second acquisition of Lightwire for $241 million in February 2012. The optical networking segment is at the cusp of a new wave of investment by service providers who are preparing to integrate 100G technologies into their next-generation networks and Cisco – still in search of large-scale business opportunities to replace the router and switch markets at the heart of its past 20 years of growth – is willing, once again, to consider building new optical networking capabilities and reentering the fray. With Huawei and Alcatel-Lucent already testing 100G long-haul systems and focused players such as Infinera and Ciena building on strong relationships to develop leading-edge niche products, the window of opportunity appears to be smaller than it was when Cisco made its first unsuccessful attempt to enter the market. Cisco's failure to maintain and strengthen its capabilities in optical networking over the course of the past decade may prove fatal to its renewed attempt to develop technologies and in markets in this business segment.

IV. Cisco's Failure to Invest in the Engineering Capabilities to Succeed in Back Haul

In a mobile network, the radio base station connects the user's mobile phone to the network. It catches the radio signal. Backhaul is defined as transmitting that signal, that is, voice and data traffic from the radio base station cell site to a point of the mobile core network. Demand for backhaul is driven by deployment of new cell sites as well as the upgrade of systems to handle the throughput required by mobile technologies, such as 3G.

With the introduction of mobile broadband technologies mobile operators needed – many operators calculations showed – to quadruple cell site backhaul capacity. Existing technologies used in the 2G (GSM) standard were by and large seen as too costly. This question was closely tied to the efforts being made in global and regional telecom standardization bodies involved in setting new 3G standards for wireless broadband services between 1994 and 1999.

Given the importance of the Internet in the 1990s, IP technology could very well have been the answer. Standardization did however work to protect backwards compatibility with existing 2G infrastructure investments (TDM and SONET) as well as protecting the basic business model upon which all telecom operators traditionally have been building – the provision of high quality voice call connection priced per minute. This required a degree of network control that IP could not deliver. Instead the key actors within the standardization process opted for ATM, Asynchronous Transfer Mode.

Beside radio base stations – the very "staple good" of wireless networks – backhaul would become the big next growth-market, catching multi-billion revenues. Stakes were indeed high. Market observers, such, as Dell'Oro Group, forecasted backhaul transmission in 2003 to reach $6bn by 2007 while backhaul aggregation routers would only generate revenues of between $1bn and $2bn.

When addressing telecom operators, Cisco's initially applied the same approach as the company used for tackling the enterprise market – disruptive innovation through IP. In approaching the mobile operators, Cisco had a very clear message – do not make things unnecessarily difficult. We all know what drives the market – mobile Internet services. At the end of the day, it will all be about IP communication.

Cisco's hence centered its entry into this particular market on its radical All-IP vision, suggesting that operators should rip-and-replace existing infrastructure in one big push. Most backhaul networks are not "greenfield". Rather they are evolving adaptations of legacy backhaul networks. Throughout the growth of 2G mobile systems such as GSM and CDMA, wireless had made substantial investments in 2G backhaul technology, making Cisco's "rip-and-replace" strategy less feasible. Mobile operators were certainly inclined to leverage existing infrastructure investments as long as possible. What is more: major operators focusing on the emerging markets were still investing heavily in the expansion of their 2G mobile network. It should be noted that 2G dominated in mobile operators investments until 2008, although operators began to rollout 3G networks in 2002. The gradual migration from 2G to 3G will definitely lead to long-term co-existence of the two networks, which in turn poses a challenge in backhaul to support

the multi-service transport requirement for a longer duration. Hence, operators said no to the disruptive scenario. Rather they preferred a hybrid solution, at least as an intermediate solution.

To adapt to the demand situation Cisco offered new hybrid solutions, such as Abis optimization and MPLS, which both were designed to fit into the existing 2G and 3G standards. Cisco's business model was however focusing on "box-selling" as opposed to "system integration" typical of incumbent telecom equipment vendors. Hence Cisco's business model fit poorly with the strategy to incrementally wave-in new technologies into the complex systems.

Our interviews with mobile operators, network design consultants as well as with Cisco executives (e.g. Bengt Nordström of Northtstream Consulting and Sören Ellingsen of Cisco Systems) points to the fact that Cisco remained for a long time a "box-seller", implying that the company did not see it as its main task to be responsible for integrating the hardware-software solutions into the customer's sites. The degree of complexity in a network is considerable. "Just tuning the radio network is a difficult thing to do. One vendor has a RNC with something like 10.000 parameters that can be changed. It is one of the most complex pieces of equipment ever produced…" Implementing new technologies into the system often have far reaching consequences. (HR, Vol 2, No2, 2004 p 55)

Cisco's general business model as a box-seller only lent half-hearted support in the sales process to the company's attempt to meet customer requirements concerning system integration. Hybridization of broad band technologies in complex systems, as Cisco tried to do with its Abis optimization product, required not only deep understanding of the customer's system and all its unique solutions but also a big catalog of reference cases. In contrast with Cisco, incumbent mobile system vendors have traditionally seen it as a necessary service to stand behind and guide the implementation of their offerings into the customer's network. Such customer support has long been the hallmark of telecom equipment vendors, requiring deep system integration capabilities. Vendors need to apply these insights in system integration in general, but also apply a "catalog consisting of 100s of used-cases which the vendors have built up over the years", as one of our informants put it.

All these misfits between Cisco's strategy and the demand situation impacted Cisco's performance in backhaul negatively. More than anything else, however, it was Cisco's one-sided specialization in fixed line LAN that limited its potential to grow in the mobile backhaul space. This is obvious from our discussion about how radio-centric vendors with their portfolios of microwave transmission products, such as Ericsson, dominated the segment. The investigation of the backhaul market has a bearing, it appears, on a bigger issue that may shaped the relations between incumbent mobile system vendors and new entrants.

The successful radio base stations suppliers dominated in not only radio access and backhaul, but they also dominated in mobile core. In the competitive landscape, the market became divided into four tiers:

1. Ericsson has continuously been in the forefront, despite its difficulties when industry demand crashed between 2001 and 2003, to launch IP-based products. From 2007 and onward, Ericsson plays the dominating role in mobile core.
2. Alcatel, Lucent, Nokia and Siemens battled for second and third positions.

3. Router vendors such as Cisco, Juniper, Tellabs, Starent and Ciena were players in some sub-segments of the market where the nodes were building mostly on IP routing technologies and less on TDM, i.e. GGSN and 'policy' servers. Just as in backhaul, Cisco and Juniper has been dependent on re-seller arrangements and strategic alliances for finding channels into the operators.
4. Huawei – the Chinese full-service vendor – is the only new entrant that gained real traction in mobile, independently of incumbents.

Despite their leadership in IP fixed line technologies, Cisco, Tellabs and Juniper have had very little "account control" and struggled hard to remain in this market. Between them, their combined market share never went beyond one quarter of the GGSN router sales, which in itself represented a very small part of mobile core. They played no role at all in products building on combinations of TDM and IP, such as SGSN nodes. While their lack of experience of voice centric TDM technology may partially explain this pattern p, one should not overlook the overriding importance of the relationship between sales of radio base station and sales of mobile core products.

Both Cisco and Tellabs have later commented on the critical importance of radio technology in mobile infrastructure markets. Tellabs has publically, in a press release, cited incumbent's policy to accept low margins in routers and switches to leverage the all-important radio base station business as a key reason why the company considered withdrawing from mobile core despite major investments throughout the 1990s (Tellabs 2012). Cisco describes in a white paper on the Evolution of Mobile Network (Cisco 2010) how incumbents worked through the "network-centric model" where the radio base stations are of primary importance and the most differentiating element of the network.

Other nodes, be they ATM or MPLS, are more or less subordinated elements in the sense that they are reduced to a non-differentiating "necessity to facilitate transport of subscriber data" (Cisco 2010, 3). In this model, incumbents with particular strength in mobile broadband radio technology, that is, WCDMA radio base stations, will dominate the industry and command high prices. By contrast, Cisco sketches a different scenario – the service-centric model – where the radio base stations are standardized on the principle of Ethernet, meaning that they are important but not exclusively differentiating nodes. On this view "…the radio base station connects subscribers to the internet much the same way that an Ethernet-port connects a device to a fixed network…" (Cisco 2010, 3) The reduced role of the radio base stations should be been in the light of the increased importance of the other IP/Ethernet-based elements of the wireless network: "The IP network…", Cisco (2010, **) writes, "…is considerable more important [under the service centric-model], helping with optimal service delivery…" The operative concept here is service delivery, implying that the mobile operator's ability to offer differentiating services to its subscribers will not be linked to the radio base stations but the IP-nodes.

On the one hand, Cisco naturally advocates IP as a general platform for service oriented mobile communication systems. As of 2012, that idea is not particularly radical. It is noteworthy that the key actors in the telecom business chose IP as the basis for 4G mobile systems, much the same way that they pegged the 3G WCDMA standard on ATM. Still, most backhaul networks are not

“greenfield” cases, but rather backhaul networks that are evolving. This evolution requires a smooth and risk-free migration plan from legacy networks to next-generation packet-based communications. This is paramount for network operators. Replacing legacy TDM networks with IP-based networks must be carefully planned as it involves a gradual process, with a hybrid network having to provide simultaneous support of TDM and IP/Ethernet communications.

Even being an advocate for a radical transformation of connection-oriented networks to service oriented networks, as we just concluded from the above, Cisco seems to have learned the lesson. Rather than remaining a box-selling outsider without much strength in either system integration or radio, it has been since at least 2009 focusing on presenting themselves as a solutions provider. Central to this approach was the $2.9 billion acquisition of Starent Networks, Cisco’s most significant M&A-activity since the much-debated and ultimately failed unsuccessful acquisition of Linksys (and other consumer-oriented companies) in 2003. One the one hand, Cisco’s routers were not always seen as an obvious choice. "Our channel checks…” one analyst has observed, “…have indicated Cisco's 7600 didn't have the features required for all…[future] networks.” Many operators have selected Starent’s key product ST-40, now re-branded as ASR 5000 by Cisco. Starent’s hardware is not just an excellent choice for mobile operators, but the company has also – more importantly – gained reputation for providing stable solutions in terms of core mobile networks.

The Starent-developed packet-handling systems are geared towards and have gained traction with operators for use with the backhaul networks that carriers are creating to handle the explosion in mobile data from smartphones “Starent has given them technology and products that could be very competitive and may put them ahead of [Alcatel-Lucent] and Juniper, which are still developing their own products,” says Dell’Oro analyst Shin Umeda. “Over the next two to five years, this could represent a big opportunity in core packet networks.”

On the radio side, Cisco has downplayed Wimax. Previous to acquiring Starent, Cisco acquired WiMAX vendor Navini Networks in 2007 to become a key supplier to of WiMax RBS, particularly to Clearwire for its mobile WiMAX buildout. But leading mobile operators AT&T and Verizon -- both Cisco customers – have announced plans to adopt LTE instead of mobile WiMAX as their 4G service delivery platforms. But now that Starent fills out its mobile packet core portfolio, the only thing that Cisco is missing is radio access network (RAN). Cisco has recently announced that it will rely on third parties, such as NEC and SIAE-Microelettronica, to provide what Cisco calls a unified solution.

V. Cisco's Success in Data Centers

Cisco has historically developed networking equipment into data centers going back to the 1990's. Cisco's data center strategy reportedly began in 2002 by providing local area network storage, switches, and load balancers (2008). Cisco acquired storage switch maker Andiamo in 2002 and used the resulting storage area networking products for data centers. In December 2004, it launched a new product line based on its Actona acquisition (announced June 2004) (Reardon 2004). By 2004, Cisco teamed up with Intel to provide the switching capability (Catalyst 6500 Series) for 10GbE in the data center. In April 2005, Cisco announced its acquisition of Topspin, an intelligent server fabric switch maker that would strengthen Cisco with networking technology enabling its customers to build flexible, grid-like data centers. The next month (May 2005) Cisco publicized its intent to acquire FineGround Networks, a provider of network appliances that maximize infrastructure capacity in the data center while minimizing bandwidth usage. In August 2006, Cisco announced an investment in Nuova Systems, Inc as part of its accelerated data center strategy. In February 2007, Cisco agreed to acquire Reactivity, an XML gateway provider, for $135 million in cash (2007).

In July 2007, Cisco unveiled its Data Center 3.0 Strategy at its Cisco Networkers user conference. Its vFrame Data Center appliance would streamline the provisioning process for servers, networks, storage, and all other elements for online business applications (Musich 2007). Cisco's vFrame Data Center interoperated with servers from IBM, HP, and Dell as well as storage platforms from IBM, HP, HDS, EMC, and NetApp (2007). Following the launch of Cisco's Data Center 3.0 strategy, Cisco acquired 1.6 percent ownership of VMWare to move beyond networking into virtualization solutions. This VMware ownership stake starting pitting Cisco against competitors like Microsoft, IBM, and HP as they integrated leadership in network virtualization and server virtualization to enhance the data center offering (Musich 2007). In January 2008, Cisco introduced new solutions for its Data Center 3.0 strategy, including the Cisco Nexus 7000 Series (first switches designed specifically for data center requirements and scale to 15 Tbps) (Matsumoto 2008). A few months later (April 2008), Cisco announced its acquisition of Nuova Systems, a provider of next-generation products for the data center that developed the Cisco Nexus 5000 Series.

Cisco faced increasing competition from other networking vendors, like Juniper and HP ProCurve, looking to move into virtualization. Juniper in early 2009 teamed up with IBM to deliver network connectivity for IBM's cloud computing offering (2009). To counter this competition, Cisco announced the Unified Computing System in March 2009 as part of its data center strategy, incorporating its Nexus series switches and server blades (2009). Cisco's UCS combined a UCS B-series blade server, VMware virtualization technology, a Cisco switch, and third-party tools combined in a single rackable system. The blade server put Cisco in more competition with some of its partners, including IBM and HP (Hamblen 2009). Cisco reportedly reached out to IBM and HP for partnerships in delivering its data center offering. Chambers remarked that Cisco was willing to do without its storage or server business had not IBM or HP entered a partnership with them (Matsumoto 2009). The next month (April 2009) Cisco announced its intent to acquire Tidal Software, integrating its intelligent application management and automation solutions into Cisco's data center strategy.

Towards the beginning of Fiscal 2010 (July 2009), Cisco announced new data center capabilities to make storage area networks more secure, resilient, and less costly and complex (e.g., MDS 9000 family of Multilayer Directors). In November 2009, HP acquired 3Com, incorporating its routing and network switching technology – along with 3Com's TippingPoint intrusion prevention products - into a more competitive position in the data center market (2009). However, in March 2010, Cisco's CRS-3 router was launched with a potential capacity of 322 Tbps.

In April 2011, Cisco built its Allen, Texas-based green data center (2011), and in May 2011, Cisco launched its Containerized Data Center - a portable data center suitable for transport on ships and trucks, containing all necessary servers, networking, and storage equipment ((2011). Cisco's CloudVerse framework was introduced in December 2011, enabling organizations to build, manage, and connect public, private, and hybrid clouds (2011). Cisco ended the year strong, with Cisco "essentially tied" with HP and IBM in the North American market in 4Q11 (calendar year) according to Synergy Research Group (2012).

In January 2012, Cisco reached a milestone of 10,000 customers for its UCS product line (see figures below). In February 2012, Dell announced a data center and enterprise architecture, competing with Cisco (Virtual Network Architecture). Bolstering its own position, Cisco announced its acquisition of Lightwire in February 2012, a provider of optical interconnect technology for high-speed networking. Cisco ended fiscal 2012 announcing its acquisition of Virtuata, integrating its capabilities for securing virtual machine information (in cloud and data center environments) for more consistent and enhanced virtual machine security. For fiscal 2012, Cisco's UCS servers, networking, and software was up 87% Year-over-Year in their third year, according to fiscal quarterly reports (2012).

Cisco leveraged experience of connectivity (routing and networking equipment, e.g., Catalyst 6500) in the data center to get into storage (area networking) and then move into (blade) server market, providing a unified computing, virtualization platform. Meanwhile, its competitors - server giants like Dell, IBM, and HP – entered into networking for the data center. Cisco momentarily lost business with their competitors (in networking) – e.g., HP ripped out internal Cisco network, replacing it with 3COM/ProCurve hybrid. Dell tied more closely with Brocade for SAN to fill out its data center offerings while IBM allied with Juniper for QFabric data center and cloud fabric switches.[12] Ultimately, Cisco's foray into data centers deepened its enterprise offerings, going beyond networking to virtualization and cloud computing for their installed customer base.

[12] http://www.networkworld.com/news/2011/102511-tech-argument-cisco-hp-ibm-dell-252359.html?page=2

VI. Conclusion: Innovation versus Financialization?

The aim for this research is to move beyond the superficial level of anecdotal and statistical analysis of patents and R&D-budgets to address the question of how to evaluate the extent to which the financialization of a firm may impact on its ability to develop innovative capabilities. From a methodological perspective, is also necessary to conceive that the financialization of the firm under investigation could have enhanced the firm's ability to develop such innovative capabilities.

Early in its development, Cisco had secured a huge cash flow from its leading position in the enterprise networking market with no manufacturing in the books. Its strategic choice at that point was to continue to invest in growth segments, or to become a "value company" that invests enough to keep its leadership in the segment and distribute the rest of the profits to different stakeholder categories. It appears that Chambers and his associates initially opted for continued growth, by targeting the infrastructure market in the late 1990s.

Cisco started out as IP company (adopting all the standards set by data communication companies as part of the internet standardization process). It used M&A to add new features to its core routing/switching businesses at a rapid pace. At the center of this evolution was the platform strategy revolving around the Cisco IOS software. To become a competitor in carrier grade technology, Cisco went beyond IP and the scale of enterprise level equipment. Hence it started developing a complimentary set of technologies, pertaining to optical transport (e.g ATM and SONET). At the center of this was, however, significant investment in MPLS, which was conceived as an alternative to ATM. Cisco designed MPLA in such way that it could handle IP traffic without costly and slow translation, which ATM needs to forward IP packets. It also works well with Ethernet. Cisco thought this could be a valuable technology for filling up the operators' racks with Cisco branded products.

Cisco's pre and post-merger processes in enterprise equipment built on the assumption that everything could be integrated easily with the IOS platforms. In addition, commercialization was not a problem as M&A activity only extended existing products sold in the same enterprise networking market. Everything followed an 18-month rhythm from M&A to launch of product with new features. In using the same model for very complex technologies and new markets that the company did not understand that well, Cisco came up against the limits of such a vision of innovation primarily through acquisition.

In effect, Cisco was very successful in executing small M&A with close relationship to its IOS platform technology and the existing market. However, with ATM and SONET Cisco went beyond its own model, which is also acknowledged by Cisco as it introduced the concept of "platform acquisitions". With these, Cisco's well-oiled machinery failed to deliver in 18 months because it was a completely new technology and new market that they did not understand all that well.

Business model and customer interfaces: There were many different reasons why Cisco faced so much resistance with operators in both long-haul and mobile backhaul. Cisco's acquisitions of

Pirelli, StrataCom and Monterey networks in the optical networking space were clearly less successful in terms of what they actually got in terms of technology. Also, key technology people left early on, as did important people with connections to major customers. Equally important, if not more important, was the lack of understanding of the service provider. Clearly, the message that IP would undermine the voice centric- business model on which the industry was still building (and is to this day) did not help Cisco much. Not only did the vision of "all-IP" alienate the customer, but Cisco's lacking experience and box-selling business model made it difficult to convince customers to let Cisco inside the doors, even as Cisco realized that operators were asking for hybrid solutions. Hence, Cisco had to re-sell its boxes through incumbents with massive experiences of system integration and a supportive business model.

Our study of data centers provide us with a useful contrast. Just as with the M&A activities relating to data centers, there is nothing indicating that Cisco faced problems when trying to get traction with IT-managers making decisions in the data center market. Here the competition seems to be more straight forward revolving around well-defined parameters. Note, however, that in fiscal 2012, data centers, while a growing business for Cisco, represented only 3.6 percent o its total revenues.

Architectural Advantages: Cisco realized that long-haul optical networking would became a low-margin business, particularly as the company betted on so called next-gen service providers who became the first victims of the crises in the early 2000s. The mobile infrastructure market seemed more promising; mobile operators did not fail commercially 2000-2003 as customers kept on using their mobile phones. Cisco made an attempt, as we have seen, to get into mobile backhaul. Here Cisco failed also for other reasons. The system integration capability of incumbent companies stem from architectural control and the ability of the incumbents to manage the architecture through the standardization processes. Mobile standards were primarily focusing on radio standards and other standards were following, meaning that radio standards (WCDMA) influenced related standards in backhaul and mobile core (ATM). Introducing IP/MPLS in this highly politicized environment became a hard sell, regardless of the potential merits of IP/MPLS.

Incumbents such as Ericsson and Alcatel drove standardization and architecture in such a way that they benefited radio—centric firms because their technologies were the 'bottlenecks'. One particularly compelling result of architectural control was then the ability of incumbents to bundle backhaul routers with the imperative radio base station sales, from which they generated profits until the arrival of Huawei.

In the data center case study, on the other hand, Cisco sought and won architectural control as it concentrated software platforms for cloud and resource virtualization and offered to accommodate HPs and IBMs servers in the solution, hence giving up on at least parts of that business, conceivably not the most profitable parts.

Overall, therefore, what can be concluded about the extent to which Cisco really did sacrifice innovative capability to financialisation? The answer depends on the yardstick. If we measure against the enterprise networking gear, we will have one result suggesting that Cisco became less able to disrupt market and drive out competitors through innovative technologies, such as the IP

router. If we acknowledge that Cisco's growth from being an enterprise networking company to be a supplier to infrastructure operators and service providers was a different ball game in terms of market maturity, the answer should be different. While Cisco never was successful in becoming a dominant force through disruptive technologies in the infrastructure markets, it does not mean that it lost its innovative capabilities. Cisco led the development of IP/MPLS was, providing an innovative solution to the problem of transporting IP over optical networks. It has no-doubt gained market acceptance.

The bigger picture is here about how market performance of novel communication technologies is closely related to architectural control. Cisco's effort to launch innovative products was, and remains, restricted by lack of architectural control. New technological elements needed to fit closely with the existing architecture. Technological performance of new elements depends on the architecture as much as on the element itself. Although IP was very cost efficient in LAN, it was not equally efficient in architecture where ATM was fundamental because IP transport over ATM requires slow and costly translation processes.

Financialization of the company clearly made these situations worse. First, Cisco did not use its funds for acquisitions that could have provided Cisco with architectural control, such as Nortel's UMTS business\s or its optical networking assets. Secondly, financialization also limited the company's ability to build systems integration capabilities internally. For this, it is necessary both to build the architecture and then acquire proof of successful reference projects within this architecture and this would have required a much heavier weight of OPEX in Cisco's books. Third, finalization also limited market access as the company did not make the necessary acquisitions to gain sheer account control through acquiring incumbent telecommunications equipment manufacturers.

Cisco may have learned that lesson, judging from the analysis of the data center market, but also from the acquisition of Starent Networks in the mobile space which provides Cisco with a strong software platform as well as very good hardware, making Cisco less dependent on incumbent re-sellers such as NSN.

What we have learned, above all, from the process of building the case study material, is that the electronic resources available make such a methodology increasingly feasible, albeit time-consuming. The complexity of the material available and the differing opinions voiced by industry commentators mean that it is vital to be in a position to triangulate sources and use the case studies as a basis to conduct interviews with industry experts. To date, this has only been possible in the mobile case study and the value-added has been of great benefit both to the case study itself but also in emphasizing this phase as a necessary stage in the methodology to be adopted.

Future research will thus proceed to further interviews with customers, industry experts and, ideally, Cisco executives in the three areas under examination.

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