

Working Paper

Innovation, competition and financialization in the communications technology industry: 1996-2016

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Abstract

The objective of this paper is to document the relative position of different firms in the communications technology industry to take advantage of new opportunities and the potential influence of financialization on their innovative strategy and performance. To do so, we compare the performance of the leading sixteen firms in the industry over the past twenty years and provide summaries of the impacts of stock buybacks—as the most evident manifestations of financialization—on major firms in the global industry over the past two decades. This survey then positions us to focus the key competitors in the communications technology industry today. More in-depth case-study research on the tension between innovation and financialization is proposed as an ongoing research agenda.

1. Introduction

In the high-tech sector, growing financialization has a potentially damaging influence of the development of long-term innovative capabilities (Lazonick, 2014). This impact is not easily perceived, however, and it may only appear after many years of profitability with healthy revenues from existing businesses where incumbent firms have an established advantage. In the communications equipment sector, the past twenty years provide a useful base for examining how such financialization can impact on the resource-allocation decisions made by a variety of firms from different regions in the world. Different fixed-line and wireless technologies have emerged based on different standards and uses, with firms from different, but converging industries, have transformed innovation and competition over this time period.

A report published in December 1999 by a US-based consultancy firm, Decision Resources, Inc., examined the top fifty telecommunications equipment companies in the world. The subtitle of its report asserted that “concentration, wireless, and Internet Protocol drive largest firms”. Its conclusion was that “concentration, consolidation, and competition will continue unabated as will the rollout of new technology in a world where demand exceeds supply but prices still fall” (Spectrum Telecommunications Industry, 1999, p.101). The \$10 billion already invested by EU firms Alcatel, GEC and Siemens in US acquisitions was not considered to be sufficient as “the window of opportunity for IP networking is open wide. Soon the intellectual property gap will be so large that latecomers will find entry impossible. With more than 8,000 IP developers at Cisco, and at least that many working at Lucent and Nortel (combined), the 1,000 or so at Alcatel, GEC and Siemens are insufficient to deliver on their ambitions. To compete these latter three companies will have to quickly transform their entire existing R&D teams to the IP paradigm. Ericsson, Fujitsu and NEC face a similar task but are farther behind” (Spectrum Telecommunications Industry, 1999, p.100)..

A comparison of the 1995 revenues of the top ten companies from this 1999 report with the revenues of the top global companies identified by a report published by French consultancy firm, Xerfi (2016) highlights what, in fact, transpired due to the changing nature of competition in the industry (Table 1). A comparison of the performance and strategic choices of these sixteen firms form the basis of this report.

The consolidation forecast in the 1999 report did occur as a number of players exited the sector, some in a more orderly fashion than others however. The predicted superiority of North American players in the emerging IP landscape did not play out as anticipated in the same report however. As it turned out, four of the five North American firms among the top ten competitors in 1998 did not survive the turbulence of the telecom boom and bust. Three of the four European competitors remained in the top ten twenty years later, although two of them were in the process of merging. Both a dominant and a challenging competitive force also emerged from China during this period, in the forms of Huawei and ZTE respectively, both firms not mentioned in the 1999 report. The most significant trend in terms of global competitiveness (Figure 2) is thus the growth of revenues to Asian competitors in the sector, in particular to the new market leader, Huawei whose 2016 revenues approached those of IBM and whose founder, Ren Zhengfei, announced in June 2016 a revenue target of \$150 billion for 2020 (Xuanmin and Qingqing, 2016). While the 1999 report had correctly identified the importance of the technological convergence of the telecom equipment industry towards an environment of Internet Protocol and the challenges it posed for the firms that historically dominated this sector, it erred in believing that it would be impossible for ‘latecomers’ to establish themselves.

Table 1: Comparison of turnover of ten leading communications equipment companies, 1995 and 2015 (\$bn)

<i>Company</i>	<i>Turnover in 1995*</i>	<i>Turnover in 2016**</i>
<i>North America</i>		
Lucent	21.5	
Motorola	27.0	
Nortel Networks	10.7	
Cisco Systems	4.1	49.2
3Com	0.6	
Qualcomm		27.5
Juniper Networks		4.5
<i>Europe</i>		
Marconi	1.3	
Ericsson	15.0	29.0
Nokia (NSN)	8.5	13.6
Alcatel (Lucent)**	16.1	
Siemens	12.1	
<i>Asia</i>		
NEC	15.5	6.2
Fujitsu	6.9	2.2
Huawei		60.9
ZTE		15.5

Source: Capital IQ

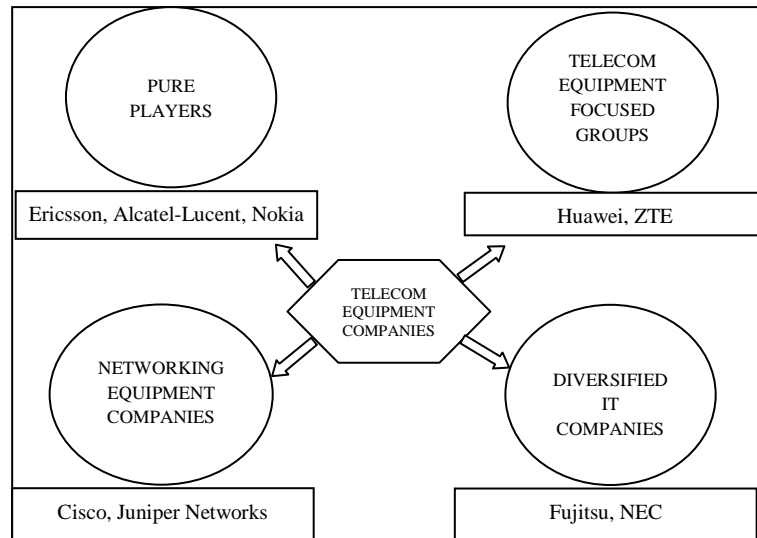
*top 10 telecommunications equipment suppliers in Spectrum Telecommunications Industry Report, December 1999

**top 10 leading global telecom equipment companies in Xerfi Telecommunications Equipment Groups – World, January 2016

The communications equipment industry is the part of the value chain of the telecommunications market that “supplies network equipment, software and services used by telecommunications carriers enabling them to deliver multiple services to end users” (Xerfi, 2013, p.19). As networking technologies converge around the Internet Protocol, competitors in the industry have different corporate backgrounds and technological paths, while the significance of the carrier segments is not the same for all players (Figure 1). Pure players such as Ericsson and Nokia generate almost all of their revenues from sales to telecommunications carriers while new entrants such as Huawei and ZTE have also developed significant mobile handset businesses, although networking equipment remains their major source of revenues. Asian conglomerates Fujitsu and NEC also sell networking equipment but these revenues only represent a small part of their very IT-oriented product and services portfolios. Finally, from the IP world, a group of US firms such as Cisco and Juniper have targeted carriers as potentially profitable customers for their networking equipment originally designed for enterprises.

As communication vendors increasingly seek to develop capabilities in relation to data analytics and the Internet of Things (IoT), they are also moving into competition with other IT service companies such as IBM. The telecommunications and IT sectors are converging in a cloud-enabled digital landscape and the ability of existing players to acquire new capabilities will be essential to their survival and success in the coming decade. Those firms that remain in the industry in 2016 have displayed such strategic agility in the past, but the technological and market dynamics are evolving and the combination of new competitors from the IT services sector along with the growing strength of the Chinese new entrants will pose significant new challenges.

Figure 1: Different types of competitors in the communications technology industry



Source: Xerfi, 2013, p.29.

As in the past, there will also be multiple opportunities for those firms that are in a position to leverage the three social conditions of innovative enterprise (Lazonick and O’Sullivan, 2000; Lazonick 2009). To profit from the new technological and market configuration, the decision makers in communications equipment firms from different industries and different parts of the world must have the incentives and abilities to direct resources to innovative investments, they must ensure that the necessary people direct their skills and efforts towards turning these investments into profitable new goods and services, and they must be able to sustain investments for a sufficiently long time to generate the competitive products that can bring financial returns.

Investors are also aware of the opportunities available as the sector expands with the inevitable adoption of the IoT. It is typical for industry commentators to cite Cisco’s forecast that there will be 50 billion IoT devices by 2020 and to foresee a massive associated market. A financial website, for example, stages that “The IoT is projected to be worth \$7.1 *trillion* by 2020. Yes, trillion. And that's just a conservative estimate. Cisco Systems thinks that number could climb as high as \$19 trillion by 2025” (Neiger, 2016). Such optimism in the financial sector with regard to the communications equipment sector is not recent and the phenomenal growth of Cisco, in particular, was linked to the emergence of the “new economy business model” during the Internet bubble (Carpenter et al, 2003). Since the downturn in the sector however, in 2001, Cisco has also become a company that is representative of another aspect of the financialization of high-tech industry which is the growing tendency for firms, particularly US firms, to buy back their own stock. In his analysis of the 459 companies that were in the S&P index from 2006 to 2015, Lazonick (2016) found that 54% of their earnings were used to buy back their own stock, while dividends accounted for a further 37% of earnings. He argues that such practices leave little funds available for investment in “productive capabilities or higher income for employees” and that, for this reason, “corporate profitability is not translating into widespread economic prosperity” (Lazonick 2014, p.48). Cisco began buying back its own shares in 2002 and in the 14 years since then, it has spent \$97.5 billion on such repurchases. During this time, it has spent \$73.7 billion on R&D. Lazonick has argued that buybacks on such a scale represent the “financialization” of corporate resource allocation, referring to the use of a financial measure such as earnings per share to evaluate the performance of a company rather than by the goods and services it produces, the customers it serves and the people it employs. Cisco’s attempted move into the carrier market did not prove as successful as predicted, and it has been argued that financialization is part of the explanation of this failed diversification (Bell et al., 2012). There

thus appears to be a potential in this sector for financialization to undermine a firm's acquisition of the capabilities necessary for innovation.

The objective of this paper is to document the relative position of different firms in the communications industry to take advantage of new opportunities and the potential influence of financialization on their innovative strategy and performance. To do so, we provide summaries of the impacts of stock buybacks—as the most evident manifestations of financialization—on major firms in the global industry over the past two decades. This survey then positions us to focus the key competitors in the telecommunications technology industry today on which more in-depth case-study research on the tension between innovation and financialization should focus—which is an ongoing research agenda of ours.

The paper will begin with a general presentation of the key firms present in the sector and their relative performance over the past twenty years. This time period was chosen as it allows for consideration of a number of significant technological developments. In fixed line telecommunications, it was only in the mid-1990s that optical networks moved from research laboratories into the broadband networks needed to support the growth of the Internet. Simultaneously, the rapid adoption of 2G mobile phones was creating fertile terrain for the future growth of mobile Internet. Finally, the emergence of “new economy” firms in the late 1990s in the US paved the way for a new type of corporate business model in which the role of the stock market had become central to the accumulation of innovative capabilities.

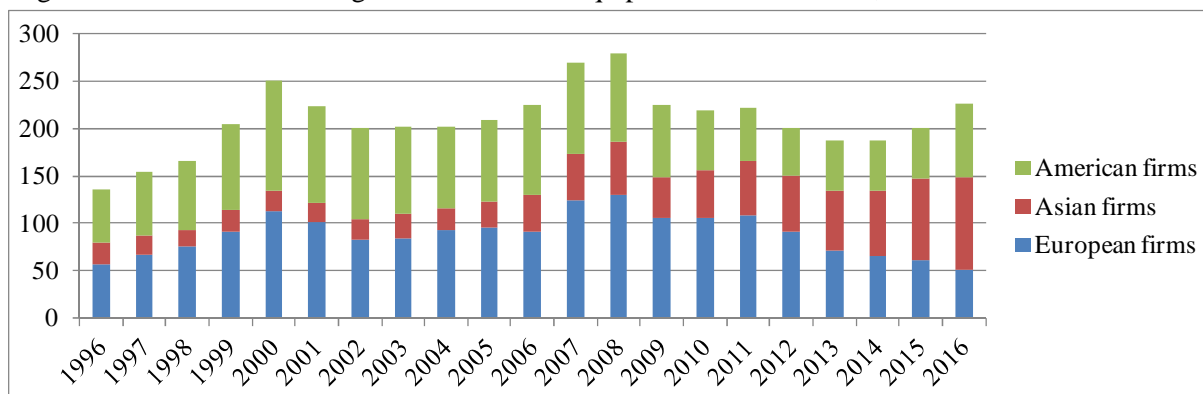
Having summarized the overall performance of different regions in the world, the specific trajectories of the leading firms will be recapped. The objective is to identify periods in the firm's past twenty years where financial influences may have had a significant impact on its strategic and organizational choices. The next section details how technological and market dynamics have been evolving in the sector and how these have influenced the trajectories of the firms presented in part 2. Finally, a comparison of the performance of ‘financialised’ v non-financialised firms analysed the outcome of how different types of firms addressed these evolutions and benefited, in the long term, from the opportunities. Finally, financialized and non-financialized firms are compared in terms of their ability to develop innovative capabilities by generating sufficient financial commitment to sustain investments, by exercising the strategic control needed to allocate resources to enhance capabilities and by engaging in organizational integration to incentivize employees to engage in collective learning processes to develop new products and services for existing and emerging markets.

Relative positions of North American, European and Asian firms

Between 1996 and 2016, the revenues of the top communications equipment suppliers have grown in a cyclical manner (Figure 2)¹. Revenues soared from \$140 billion in 1998 to reach \$257 only four years later in 2000. Total revenues subsequently fell to below \$210 billion by 2003 in the aftermath of the bursting of the Internet and telecom bubble. Growth subsequently picked up to achieve a peak level of revenues of \$287 in 2008 for the leading 16 companies. The financial crisis combined with market saturation for certain technologies has limited growth since then. 2016 revenues of \$232 billion are fairly representative of the sector's revenues for the six-year period since 2010.

¹ The numbers for these figures are based on the communications-equipment revenues of the sixteen firms in the sample, considered to be the leading telecommunications equipment firms between 1996 and 2016. The raw data is presented in Appendix 1.

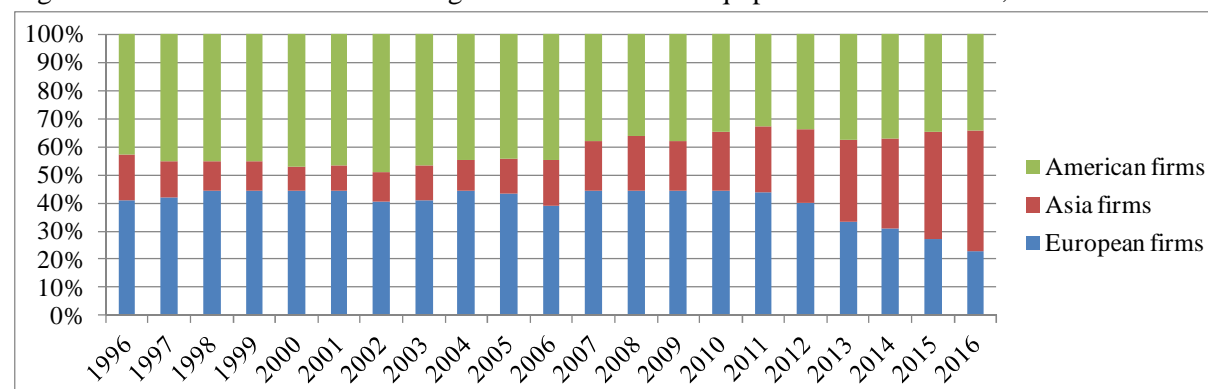
Figure 2: Revenues of leading communications equipment manufacturers, 1996-2016



Source: Capital IQ, Factset, Annual Reports

In the mid-1990s, the future of European equipment manufacturers was a cause for concern, and it was generally believed that the North American vendors were in a better position to reap the rewards of the future growth in the sector. Until 2011, however the European vendors grew revenues sufficiently to retain over 40% of the revenues of sector's leading firms (Figure 3). The significant disruption in the market has occurred not because of the successful transition of the North American vendors but primarily because of the success of new entrants from Asia, in particular Huawei.

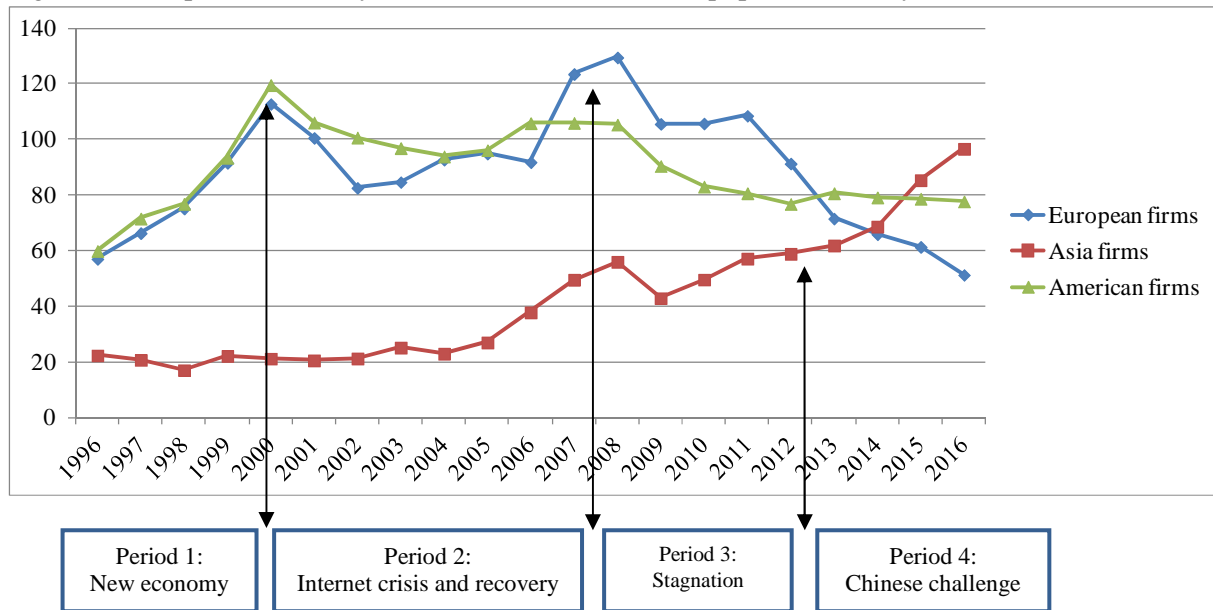
Figure 3: Share of revenues of leading telecommunication equipment manufacturers, 1996-2016



Source: Capital IQ, Factset, Annual Reports

To address the comparative competitive dynamics, the twenty-year period of the study is broken down into four phases (Figure 4) that correspond to periods in which different dynamics dominated the sector. In period one from 1996 to 2000, the “New Economy” model was emerging from Silicon Valley along with the growth of the Internet. During this period, new entrants from the enterprise IP-world, led by Cisco, eyed the communications carriers and their significant investments with growing interest. Incumbent equipment vendors were adapting at different paces and with different outcomes. The bursting of the Internet bubble and the subsequent telecom crisis and recovery define period two from 2001 to 2007. The next downturn from 2008 to 2012 corresponds to phase 3 of the study period, followed by the most recent period from 2012 to 2016 when the Chinese challenger, Huawei, repositioned itself as leader for the next phase of growth in the sector.

Figure 4: Four periods of analysis of the communications equipment industry, 1996-2016



The following section will present in more detail the trajectories of the sixteen leading firms in the sixteen leading firms in the communications equipment sector. Their origins, main growth segments and their performance over the four periods will be summarized in order to provide details for the analysis of their level of financialization. Finally, we summarize the key technological and market dynamics that were present in the four periods of the study.

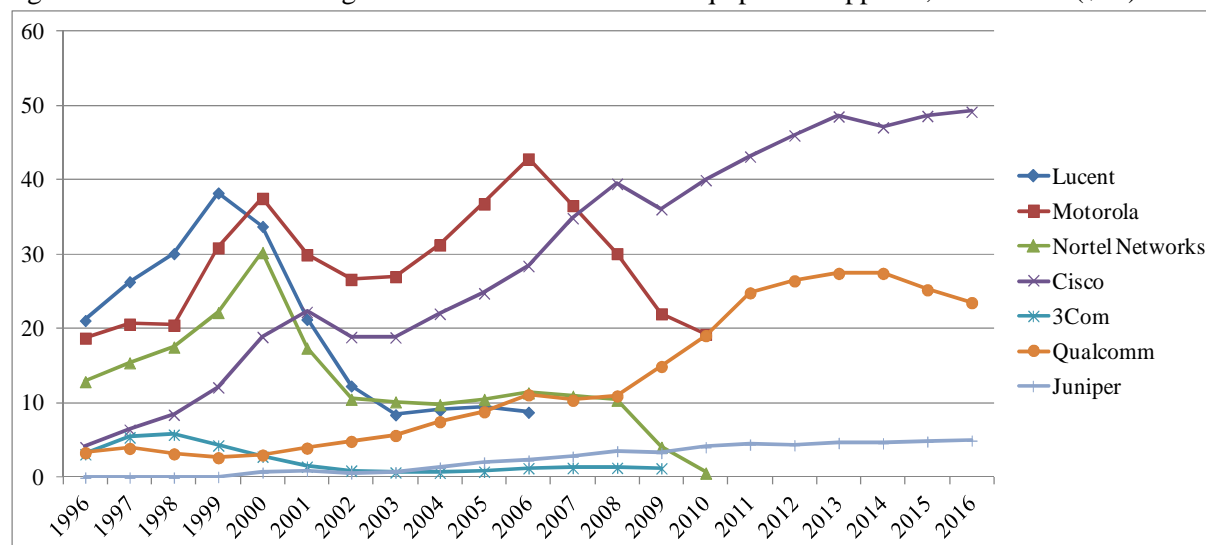
2. The trajectories of communications equipment suppliers, 1996-2016

The past two decades in the communications equipment sector have not seen the expected demise of the European vendors and the dominance of North American vendors. Nonetheless there have been dramatic changes in the corporate landscape and the market share of Europe has been in decline since 2011. The market share has primarily been lost to new entrants from Asia, however. To understand fully the competitive dynamics of the four periods being studied, each firm's origins, development and strategic choices over the time period are reviewed.

2.1 Financialized North America firms

Of the total \$140 billion of revenues generated by the leading thirteen companies in 1996, six North American firms (Figure 5) represented \$60 billion or 43%. Of this total, \$50 billion came from the revenues of the top three North American firms at that time in the sector: Lucent, Nortel and Motorola. Twenty years later, none of these three firms remained in the sector. Over 63% of the total US revenues from the three US firms remaining in the sample in 2016 were generated by Cisco whose revenues had grown to \$49 billion with Qualcomm's \$24 billion revenues representing another 30% of the total for leading US firms in the sector. The other significant US firm in 2016 was Juniper with just under \$5 billion in revenues. Overall these three remaining US firms represented 34% of the total revenues of the nine leading firms remaining in the sector in 2016.

Figure 5: Revenues of leading American communications equipment suppliers, 1996-2016 (\$bn)



Source: Capital IQ, Factset, Annual Reports

In terms of percentage of overall turnover for the group studied, the performance of North American firms in the communications equipment sector suggest that US-based networking firms benefited from their superior IP-related capabilities as was predicted in the late 1990's. In parallel, however, two of the continents historically innovative firms in the sector – Lucent and Nortel - declined and disappeared and Motorola proved unable to recover from a poor investment decision in a global satellite system in the late 1990s and then, perhaps of more significance, \$8 billion in stock buybacks 2005-2007 as it missed the smartphone revolution that occurred in the mobile market after Apple's successful launch of the iPhone in 2007. Revenues in the remaining four firms have not been growing significantly for the past five years and their ability to take advantage of the coming decade of opportunities in the new network configurations is not certain. The twenty-year history of each of the seven US firm in the study highlight not only the technological and market dynamics that can threaten corporate longevity in globalized, high-tech markets but also the dangers of financialization for the long-term accumulation of capabilities necessary to compete in such markets. The brief description of all these US companies that follow will emphasize elements that explain why they are subsequently classified as “financialized firms”.

Lucent

Lucent's acquisition by French firm, Alcatel, in December 2006 is perhaps the most dramatic example of corporate demise among North American firms as there were very few firms that could claim to have the financial and technical resources that the US firm possessed in 1996 (Lazonick and March, 2011). Lucent Technologies was founded that year as a “127-year-old start-up” when the equipment division (which until 1984 had been Western Electric) was spun out of AT&T along with the prestigious Bell Labs R&D facilities. From serving the equipment requirements of a national long-distance carrier and the regional Bell operating companies (RBOCs), Lucent was now meant to compete on a global arena. Its \$20 billion in revenues at the time of its creation came from ten existing business units and an eleventh division was formed to sell integrated solutions. During the frenzied growth years of the Internet boom of the late 1990s, Lucent divested itself of several of these businesses and continued to do so in the downturn that followed. It initially spun off its business communications systems unit in 2000, as Avaya, because it was growing slower than other business. The same year, it decided to spin off its red-hot microelectronics unit, and this division was launched on the stock market as Agere in an IPO in April 2001. Finally, its networks products unit was sold in

part to Tyco International in December 2000 and in part to Furukawa Electric in November 2001. To build capabilities to address new opportunities, the company engaged in eleven data networking acquisitions between May 1998 and July 2000. One, in particular, Ascend was notable for its cost of \$24.1 billion, although the acquisition was paid for in Lucent shares. Lucent was thus seeking to establish itself as a competitor to Cisco but the company did not succeed in gaining traction in this segment of the market. Neither did Lucent successfully penetrate transform its “incumbent advantage” with legacy customers into strong competitive positions in other emerging sectors such as optical networking and wireless. In the former technology, it was facing stiff competition from Nortel, the leader in the sector, and Alcatel, a strong challenger and, in the latter, Lucent needed to invest in both the existing generation of technologies outside of the US, along with the new generation. In addition, legacy customers for its core networking products were also diversifying their suppliers to push down prices. Thus, although revenues from Lucent had almost doubled between its launch in 1996 and September 1999 when it recorded sales of over \$38 billion, it was not apparently engaged in building the long-term capabilities that were needed to guarantee a successful business transformation.

While the downturn that hit the sector between 2001 and 2003 affected all competitors, Lucent’s competitive disadvantages became increasingly apparent when growth re-emerged. As the growth came from wireless take-off and emerging markets, it became increasingly evident that the company had neither developed sufficient competencies in the GSM market nor sufficient market presence outside of the US. Although a merger of equals with Alcatel had been proposed and rejected in 2001, Alcatel finally acquired Lucent in 2006. To an extent, Lucent was unlucky that its year of “birth” in 1996 had coincided with a unprecedented period of rapid growth and decline during which its strategic decisions were influenced, in part, by the incredible success of Cisco, a Silicon Valley company entering the telecom equipment market from its IP enterprise base. However, Lazonick and March (2011) have carefully documented the parallel influence of financial markets on the decisions taken by the Lucent’s chairman, Henry Schacht and its CEO, Rich McGinn. These decisions include the spin-offs of lower-growth businesses and high-profile acquisitions to boost share price, excessive use of risky vendor financing to increase sales and, finally, the misreporting of its sales performance that led to an overstatement of revenues of \$700 million in 2000. When he stepped down in 1998, Henry Schacht was able to cash in stock options worth \$65 million and, in that fiscal year, Rich McGinn was paid \$25.3 million, including \$3.6 million from exercising stock options.

Nortel

Nortel’s bankruptcy in 2009, the largest in Canadian corporate history, was a sad end for a company that had been founded in 1895 as the Northern Electric and Manufacturing company. Nortel was the name adopted by the company for its 100th anniversary in 1995 and, at this point, the company was poised to benefit from both its relationships with US service providers and its leadership position in optical networking and potential strengths in wireless. The company made a significant acquisition of California-based Bay Networks in August 1998, and the \$9.1 billion paid represented 26% of the company’s shares at the time Nortel went on to make an additional \$12 billion in acquisitions, mostly in the US, using its stock as an acquisition currency, as it proceeded with its “right-angle turn” away from its legacy businesses and into segments linked to the growth of the Internet and wireless segments. Poor integration of these acquisitions, however, meant that the company was in a vulnerable position when the downturn hit, in particular as a glut in optical long-haul networking equipment led to a collapse of sales for the division. The division’s revenues fell from a high of over \$7.9 billion in 2000 to under \$3.3 billion in 2001, an annual decline of over \$5.6 billion, representing over half of the company’s lost revenues for that year. Despite the recovery in the sector, the firm had not been able to invest in new generations of wireless technology and its revenues never picked up from a \$10 billion floor in 2002. As part of its attempts to stay afloat, Nortel sold its UMTS assets to Alcatel in 2006 for

\$320 million (Le Maistre, 2006), thus losing valuable customer contracts that would allow it to cooperate in developing future generations of mobile technologies.

Without a foothold in one of the key existing generation of mobile contracts and without having developed sufficient IP capabilities to gain traction in the fixed network, Nortel's days were numbered. What remained of the company's technological assets were shared among firms who had been more successful in navigating the downturn. Ericsson acquired Nortel's CDMA and LTE assets for \$1.13 billion and part of the GSM business. Avaya bought the Enterprise Solutions division for \$900 million. Its optical networking group was sold to US niche player, Ciena, for \$774 million in March 2010 as part of the liquidation proceedings.

As with Lucent, the top management of Nortel profited handsomely during the growth period. CEO John Roth was paid over \$100 million in 2000, 91% of which was from exercising stock options. He was also given a bonus of \$5.6 million. Also, as with Lucent, Nortel was found to have been engaging in misleading accounting practices although, in Nortel's case, this occurred later, in 2003, after the replacement of John Roth by Frank Dunn, Nortel's Chief Financial Officer. Dunn's dramatic restructuring of Nortel included laying off 60,000 employees, almost two thirds of its staff, and writing down \$16 billion in assets in 2001. A subsequent return to profitability for the company in early 2003 triggered a bonus payment of \$70 billion to the top 43 managers with Dunn receiving \$7.8 million. In October 2003, however, an external audit led to the recognition of incorrect statement of liabilities for 2003 and, more significantly, incorrect reporting of revenues for 1998, 1999 and 2000. \$8.6 billion in bonuses were returned by senior executives for errors linked to the most recent example of incorrect reporting (Hunter, 2002). Three senior Nortel executives, including Frank Dunn, were fired in April 2004 and charged with fraud but later acquitted.

Motorola

Motorola is the third example of a North American firm that possessed significant capabilities at the start of the period examined but that did not survive intact. Unlike the other two companies, Motorola's strengths were in the area of wireless networking and handsets. Originally founded in Chicago in 1928 as Galvin Manufacturing Corporation, Motorola went public in 1943. The company opened its first R&D lab in Arizona in 1955 and went on to develop pioneering technologies in radio, television and telecommunications for consumers, firms and the government. It's first hand-held mobile phone was demonstrated in 1973 and it launched its first commercial model with FCC approval ten years later. By 1998, cell phones accounted for two thirds of Motorola's \$20.5 billion in revenues. In that year, however, its market share in this sector was overtaken by Nokia. Semiconductors accounted for over \$7.8 billion of the company's revenues but its growth had stalled and a part of the business was sold the following year. Motorola acquired General Instrument in 1999, the leading provider of TV equipment to cable operators in the US. Between 1997 and 1998, Motorola spent \$5 billion investing in Iridium, a company formed to launch 66 satellites to support a global network of phones and pagers. Unfortunately, the forecast market for bulky satellite phones was not realistic and the bankrupt company was sold in 2000 to a group of private investigators with the support of the US Defense Department for \$25 million (Vernon, 2007).

Motorola difficulties in the downturn mirrored those of the other companies and its workforce fell from a peak of 150,000 in 2000 to 93,000 in 2001. In 2003, however, the company's fortunes were revived with the success of its Razr mobile phone model and its revenues soared to \$40 billion in 2005. This proved to be the company's most successful year in its history, as the arrival of Apple's iPhone proved to be its undoing. During this crucial phase of market transition to the smartphone, Motorola was engaging in its first significant experience with share repurchasing. Already \$1 billion in 2005, the company repurchases rose to almost \$4 billion in 2006 and \$3 billion in 2007. In 2006, Motorola sold its automotive business, including its telematics systems, to Continental for \$1.6 billion.

With revenues continuing to fall and an unsuccessful partnership with Apple behind it (Vogelstein, 2008), Motorola's infrastructure business was finally sold to Nokia Siemens Network in 2010 for \$1.2 billion and what remained of the firm was split into two separate companies in 2011. Motorola Solutions was created from the part of the company that services a niche in security communications and what was left of the cellphone vendor remained and was renamed Motorola Mobility (Ante, 2011). Google acquired Motorola Mobility in August 2011 for \$12.5 billion but subsequently sold it to Chinese PC manufacturer, Lenovo in October 2014 for approximately \$2.9 billion. Google retained ownership of Motorola Mobility's patent portfolio, however.

3Com

3Com was one of Cisco's most direct competitors in the mid 1990s. Founded in 1979 in California, the company provided enterprise and network gear and its revenues had grown to over \$5.7 billion ten years later. This total includes \$1 billion in revenues from the 1997 acquisition of US Robotics whose modem business moved the focus of 3Com's portfolio away from the central network functions of routers and switches and towards more specialized access equipment. US Robotics also owned Palm, a handheld organizer that was growing in popularity. The company decided to exit the core router and switch market in June 2000 and in July 2000, it spun off Palm as an independent company along with US Robotics. In parallel, the company made an ill-fated move into the consumer appliance business buying a radio internet startup for \$80 billion and launching two products that were withdrawn from the market within a year.

Between 1999 and 2001, 3Com spent on average \$500 million on share repurchases annually, at the same time as its cash cow business, network interface cards, was facing obsolescence. The company was forced to reduce its workforce drastically from 12,000 to 2,000, and, in May 2003, the company moved from California to Massachusetts. 3Com and Huawei announced a joint venture, called H3C, but concerns about cyber security risks led to the resignation of H3C's chairman and CEO in August 2006. Bain Capital offered to acquire the joint venture in 2007 for \$2.2 billion with minority equity financing from Huawei but the deal was blocked by the Committee on Foreign Investment in the US (CFIUS), a 12-agency government panel where "a number of lawmakers had expressed concern about the security implications of allowing a Chinese-owned entity to exercise influence over the technology company" (Wall Street Journal, 2008). In 2010, 3Com was acquired by HP for \$2.7 billion.

Qualcomm

Of the four remaining US companies in the sample of firms, Qualcomm is the firm whose destiny is most closely linked to the fortunes of wireless standards. The company was co-founded in 1985 by a professor at Cornell, MIT and UC San Diego, Irwin Jacobs and others involved in developing specialized integrated circuits used for digital radio communications, including services for satellite locating used by long-haul trucking firms. This original technological solution was based on CDMA-based satellite systems and the company began developing the first CDMA-based mobile base station in 1990. Unable to achieve sufficient reliability, the company licensed the technology to Nortel in return for their help improving the performance of the switching capabilities. Established as a standard in 1995, the company subsequently went on to participate actively in the development of the CDMA 2000, WCDMA and LTE standards. In 1999, Qualcomm sold its base station business to Ericsson and its mobile phone manufacturing business to Kyocera, a Japanese manufacturer of specialized electronics products.

The company's revenues increased with the success of its CDMA technology, IS-94, but its profits have increasingly come from its patent portfolio rather than from its remaining chip business. Revenues have been declining from their peak of almost \$27.5 billion in 2013 and, in 2016, while

chips represented \$15.4 billion in revenue and \$1.8 billion in profits, royalty licensing had \$7.6 billion revenues and an astonishing \$6.5 billion in profits.

The company began repurchasing its own shares in 2005 and has spent a total of over \$30 billion in the eleven years since then. In 2015, under pressure from hedge fund Jana Partners, it spent a record \$11.25 billion on share buybacks. In July 2015, it also announced it would cut approximately 15% of its workforce, representing 4,700 jobs. In fiscal 2015, however, the firm reported that it had paid its CEO, Paul Jacobs and his successor, Steven Mollenkopf a combined \$117.7 million, almost all of which was stock-based pay. (Melby and King, 2015). As is invariably the case, the reported compensation figures include ‘estimated fair values’ of stock-based pay, which as Hopkins and Lazonick (2016) have shown, tend to bear little relation to actual realized gains from stock-based pay, if stock prices can be increased. By jacking up stock prices and increasing earnings per share (EPS), stock buybacks increase actual realized gains.

Under investigation in the US, Europe, Korea and China for antitrust practices, Qualcomm nonetheless received approval from US antitrust regulators to acquire NXP Semiconductors for \$47 billion. Qualcomm is also embroiled in legal wrangles with Apple over royalty payments and Apple announced in April 2017 that it was suspending payments to Qualcomm from its contract manufacturers until legal issues were settled (Bradshaw, 2017).

Juniper Networks

Juniper Networks is the company in the sample whose core technologies are closest to those of Cisco. The company was founded ten years after Cisco in 1996 and went public in 1999. Its founder, Pradeep Sindhu, was a scientist at Xerox’s Palo Alto Research Centre (PARC). Selling initially to ISPs, Juniper had revenues of \$673 by 2000 and had grabbed a significant share of the core router market from Cisco, who had benefited from a virtual monopoly until then. Since then, the company’s revenues have grown steadily to reach almost \$5 billion in 2016.

As it went public on Nasdaq in the Internet boom, Juniper Networks attracted a lot of investor attention and its shares rose by almost 500% within less than a year, giving it a market capitalization of \$30 billion. The company was being compared to a “young” Cisco. Unlike Cisco, however, Juniper has tended to favour organic growth. Nonetheless, it has made several significant acquisitions. In 2002, Juniper acquired Unisphere (Raynovich, 2002), a US company that had been created by Siemens from its US acquisitions during the boom of the late 1990s and moved into the edge router segment. It acquired NetScreen technologies in 2004 for \$4 billion (Matsumoto, 2004). Acquisitions since then have generally been for early-stage startups. Juniper Networks is recognized for paying its engineers well and for investing in training, a characteristic of the company that has drawn the attention of billionaire activist, Paul Singer who runs Elliot management².

Significant share repurchases began at Juniper on a regular basis from 2007 and the total amount spent on buybacks over the past ten years is over \$6.1 billion. For a number of years, Juniper has been the subject of sustained challenges about its management from Elliot Management. Singer had acquired 6.2% of the company’s shares by January 2014 and published a report criticizing the company’s management, its strategic choices and its inefficient capital structure. Juniper’s initial proposals to buy back shares and cut costs were not considered sufficient and the company appointed two new board members who met with Singer’s approval in 2015 (Chirgwin, 2015).

Cisco

At first glance, Cisco’s performance over the period under review is undoubtedly the most impressive of the North American firms studied. From revenues of just over \$4 billion in 1996, the company had

² <http://www.bradreese.com/blog/1-16-2014.pdf#page=13>

grown to achieve revenues of almost \$50 billion in 2016. Its growth has stagnated however since 2013 as growth rates have fallen in its core segments of network routers and switches. Founded by a husband-and-wife team employed at Stanford University in 1984, Cisco received \$2.5 million of venture capital from Sequoia Capital in 1987 (Young, 2001). Sequoia partner Donald Valentine, who would have a long and close relation with the company, then recruited a professional CEO in the person of John Morgridge, who continued as Chairman of the company until 2006. The company went public in 1990, by which time it had \$69 million in revenues and 254 employees. The founders left shortly afterwards and sold their two thirds of the company back to Cisco for approximately \$170 million. John Chambers became CEO in 1995 and remained in this role until 2006. He retired as CEO in 2015 and was replaced by Chuck Robbins.

In its early years of growth, Cisco was uniquely positioned to respond to the growing need on the part of businesses and other organizations to link their local area networks (LANs) in geographically dispersed locations to wide area networks (WANs). As it offered software for all possible protocols, Cisco's internetworking technology was rapidly adopted and diffused. In 1993, when Cisco learned that some major clients were considering the purchase of a lower technology solution, switches, Cisco acquired the supplier, Crescendo, a loss-making manufacturer with \$10 million in revenues for \$95 million. As sales of switches subsequently soared to reach \$500 million within eighteen months, the Crescendo deal thus became "the genesis of Cisco's acquisition strategy" (Bruegger and Capron, 2010). Crescendo's founder, Mario Mazzola, not only went on to become the company's Chief Development Officer but he also played a significant role in Cisco's strategy of technological "spin-ins" developed in the late 2000s where executives left the company to create a start-up with Cisco capital that was later acquired by Cisco (Matsumo, 2008). In 2001, Mario Mazzola became Cisco's Chief Development Officer, as head of the newly created Chief Development Organization (CDO). He reported directly to John Chambers and the CDO grew to become "the largest functional group within Cisco, with over 30,000 employees"³ and has been considered by an insider as "responsible for keeping Cisco's gross margins above 60 percent for years longer than experts ever thought the company could" (Sidhu, 2010, p.14).

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 (Paulson, 2001). 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. 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. During this period, Cisco became momentarily the most valuable company in the world, with a market capitalization of \$541 billion in March 2000.

Since 1998, Cisco had been using its highly-valued stock to move into the optical networking industry with a view to developing carrier-class equipment and addressing the booming market for telecommunications and internet service providers. Such equipment, however, requires rigorous testing and Cisco had been making its first major investment in manufacturing to develop in-house expertise in the more complex systems integration capabilities required by carrier-class optical networks. When the bubble burst in the telecom infrastructure market, however, Cisco found itself with its first loss in its corporate history. The loss of slightly over \$1 billion was largely due to a charge of \$2.5 billion, incurred by Cisco as a result of fixed agreements it had entered into with

³ "Integrated Workforce Experience Case Studies. Central Development Organization: IWE Portlets", http://www.cisco.com/web/about/ciscoitwork/downloads/ciscoitwork/pdf/Trends_in_IT_CDO_Portlets_EDCS_CDETS.pdf, accessed July 26 2012.

suppliers of optical networking components. As the optical networking sector was hit by a severe glut in the downturn, Cisco's commitments proved costly. The company suffered less in terms of falling revenues than other communication equipment suppliers, however, as its main customer segments were still businesses, governments and other organizations. The company closed its newly-established optical networks manufacturing plant and initially refocused on its core businesses, in which Juniper was starting to make inroads into its dominance of the service provider market.

Over the first decade of the 21st century, Cisco's router revenues did not develop significantly from the \$7.1 billion level they had achieved by 2001. The server business did, however, progress and develop an additional \$7.5 billion to achieve revenues of \$14 billion by 2010. The additional \$14 billion in revenues over that period was primarily as a result of a number of major acquisitions. Over the 10 years between 2001 and 2010, Cisco made 62 acquisitions and a small number of them have had a significant impact on the firm's revenues.

In 2009, for example, Cisco made two large acquisitions costing a combined total of \$6 billion. Tandberg was a leading video communications supplier based in Norway and acquired by Cisco in 2009 for \$3 billion in cash. The lower priced products and services offered by Tandberg were viewed as a complementary offering to Cisco's existing tele-presence range. In fiscal 2016, Cisco's revenues from its Collaboration business had grown to \$4.3 billion, representing 11% of the company's product revenues and an 8.3% growth rate on the previous year.

Not all of Cisco's acquisitions during this period, however, have succeeded to this extent. Cisco acquired Scientific Atlanta in 2005, for example, for \$6.9 billion in cash (for which Cisco incurred its first long-term debt). At this time, Scientific Atlanta was a 54-year old Fortune 500 company with 7,500 employees, supplying set-top boxes and video distribution networks, mainly to US cable companies. Ten years later, Cisco sold the business to Technicolor for an approximate \$600 million. In 2009, Cisco acquired Pure Digital Technologies, a digital video camera manufacturer for \$590 in stock. The company's leading product was Flip, a user-friendly video camera for consumers that had sold over 2 million units since its launch in 2005. Two years later, however, Cisco announced that it was leaving the consumer electronics business and Flip was withdrawn from the market. In 2013, Cisco also sold its consumer networking business to a privately held firm for an undisclosed sum. It had entered the home networking segment back in 2003 with the acquisition of Linksys, a manufacturer of products for homes and small offices sold in retail outlets, for approximately \$500 million in stock.

Cisco thus entered and exited a number of consumer businesses during the first decade of the 21st century, before deciding to refocus on its core networked linked businesses. One of these that was reported as a separate segment from 2010 is Service Provider Video. To enhance the product offering, Cisco made a \$5 billion acquisition in 2012 of an Israeli firm, NDS. By 2013, however, the division was apparently in difficulty, the CEO of NDS had resigned from Cisco and layoffs were announced in Israel. In fiscal 2016, the division's revenues had fallen to \$2.42 billion from a high point of almost \$4 billion in 2014.

In 2009, the same year as the Tandberg acquisition, Cisco also spent \$2.9 billion in cash acquiring Starent, an advanced wireless equipment maker based in Massachusetts. Although integrating Starent's capabilities in mobile improved the performance of certain of Cisco's routers targeted at service providers, revenues for Cisco's router segment in fiscal 2016 were roughly what they had been in 2010 when Cisco integrated the Starent acquisition. Cisco has also reentered the optical networking with the acquisition of CoreOptics for approximately \$1 billion in 2010 and a second acquisition of Lightwire for \$241 in 2012. In fiscal 2016, optical networking revenues were given as an example of growth products from the category "other NGN routing products" of Cisco's

router segment. Revenues from the subsegment increased by 8% or \$378 million overall but it is not specified what proportion of these revenues correspond to optical networking products⁴.

In 2013, Cisco made a decision to acquire a New Jersey-based manufacturer of flash-memory array lines for \$450 million in cash in order to add storage capability to its growing server business. The company was renamed Invicta and the entirety of its development efforts were directed at integrating its products into Cisco's hardware. The acquisition also established Cisco as a competitor to its previous partner in this technology area, EMC. Key personnel changes, integration challenges and technical difficulties prevented successful collaboration, however, and the product was discontinued in 2015 with the lay-off of the Whiptail-Invicta employees. Cisco's entry into the data center segment, however, is considered to be an example of its ability to diversify into the service provider market to facilitate cloud deployments. Cisco's data center business had grown to represent \$3.4 billion in revenues in fiscal 2016, representing 4.5% growth on the previous year. Cisco is among the leaders in the enterprise segment along with Hewlett Packard Enterprise and Microsoft. However, the move to the cloud on the part of a growing number of enterprises is at the heart of the key dilemma facing Cisco in its future. By renting cloud services, Cisco's previous customers will no longer operate their own cloud services and thus endanger Cisco's legacy businesses.

John Chambers stepped down as CEO of Cisco in July 2015 but stayed on as Chairman. His successor, Chuck Robbins is a veteran of the company who had become its senior VP of worldwide field operations. John Chambers had already been put on a list in 2012 of "Five CEO's who should already have been fired" by Forbes magazine with the commentary: "Mr. Chambers appears to have been great at operating Cisco as long as he was in a growth market. But since customers turned to cloud computing and greater use of mobile telephony networks Cisco has been unable to innovate, launch and grow new markets for cloud storage, services or applications. Mr. Chambers has reorganized the company three times – but it has been much like rearranging the deck chairs on the Titanic. Lots of confusion, but no improvement in results" (Forbes, 2015). Few of those evaluating his performance at the time of his departure focused on the significant use of the share repurchases that was initiated and accelerated in the company under his leadership. Between 2001 and 2015, John Chambers had run a company that had repurchased almost \$95 billion of its own shares, approximately \$6.3 billion per annum for the period.

Ironically, as the new CEO of the company that had transformed the dynamics of the communications industry in the 1990s, commentators pointed out that the most significant challenge facing Chamber's successor, Robbins, would be to transform the "legacy company" Cisco to take on the challenges of a new networking world (Vanian, 2015). In fiscal 2016, under Robbin's leadership, the company bought back almost \$4.5 billion in shares.

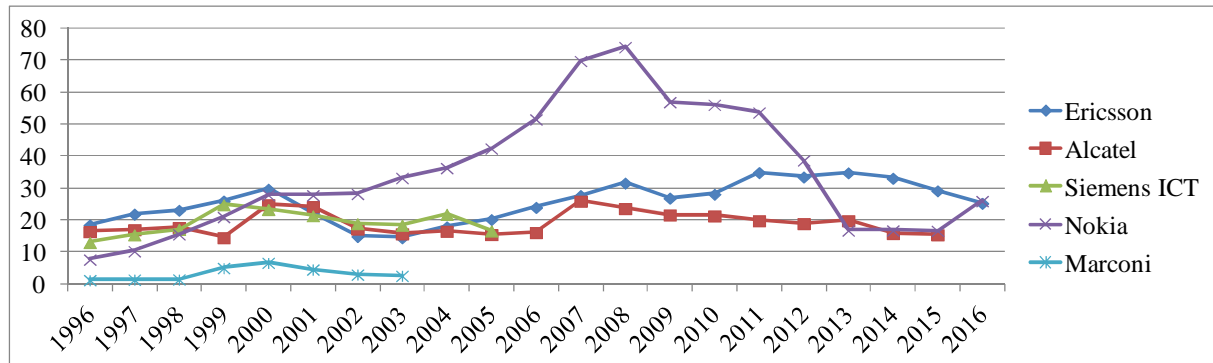
2.2 Financialized and non-financialized European communication equipment suppliers

In 1996, six countries in Europe had companies in the communications equipment sector with significant capabilities and their revenues represented 41% of the total of the 13 leading companies (Figure 6). Ericsson of Sweden and Nokia of Finland were focused telecommunications companies offering both networking equipment and, subsequently, mobile handsets. At the start of the period under study, Ericson was the largest of the European competitors with \$19 billion in revenues, representing one third of the European total for the five firms, while Nokia only represented 14% of the total. Alcatel was part of a broader French industrial conglomerate, Alcatel Alsthom and its revenues from its telecom segment were \$16 billion, representing 28% of the total for the five firms. In Germany, the ICT division of the industrial powerhouse Siemens had revenues of \$13 billion,

⁴ Cisco 10-K, 2016, p.48.

representing 22% of the total. The final company in the industry, Marconi, was the telecommunications arm of the UK conglomerate, GEC plc, which was in the process of focusing its activities on the communications sector. Its revenues at this point were only \$1 billion, representing less than 2% of the total.

Figure 6: Revenues of leading European communications equipment suppliers, 1996-2016 (\$bn)



Source: Capital IQ, Factset, Annual Reports

Within ten years, Marconi and Siemens would no longer be in the sector but their exits, in 2003 and 2005 respectively, would be very different with one driven to bankruptcy and the other exiting via a sale to Nokia Networks to focus on other opportunities. Of the three companies that remained, Alcatel initially appeared to have stabilized its position through acquiring Lucent in 2006 but, finally, it proved unable to integrate the acquisition and restore sufficient growth during the troubled post-crisis period, with Huawei aggressively entering the majority of its markets. Alcatel-Lucent was itself acquired by Nokia in 2015. Nokia's accelerating growth in mobile handsets until 2008 largely contributed to the fact that the European vendors outperformed their US counterparts as a group during phase two of the period studied. Missing out on the smartphone revolution, however, left the firm vulnerable in the subsequent period and it ended up selling its devastated terminal business to Microsoft in 2013. Its subsequent purchase of Alcatel-Lucent has left it with communications equipment revenues equivalent to Ericsson. With Nokia's \$25 billion and Ericsson's \$26 billion in revenues for 2016, these are the last two European firms in the industry and together, they represent no more than 28% of the total revenues of the firms in the group under study.

Marconi

Marconi's short-lived existence as a focused telecommunications vendor was a classic case of a financially-driven restructuring that undermined potential to build sustainable capabilities. Despite revenues growing to almost \$7 billion in 2000, the primary legacy of Marconi's transformation between 1996 and 2002 was that it became the poster child for capitalism run rampant and was termed "one of the greatest corporate governance fiascos of all time" (Plender, 2002, p.13). Marconi was the name given to the telecommunications equipment division of a large UK conglomerate, GEC, that was dismantled during the 1990s to focus on the higher growth opportunities available in that sector compared to the defense, power and transport sectors. Between 1963 and 1996, GEC was managed by Lord Weinstock with strict financial controls and tight links to the UK government. He was replaced by George Simpson, later to become Lord Simpson. Simpson had a history of successful corporate restructuring, having managed to sell Rover cars to BMW for £800 million in 1994. His close collaborator, John Mayo, who was behind the spin-off of Zeneca from another UK conglomerate, ICI, became the CFO of Marconi. GEC-Alsthom, the power and transportation division, which was a joint venture with Alcatel floated in 1998, raising £1.2 billion for GEC. In the same year, \$1.4 billion in

cash was used to buy a US software firm in the defense sector and the division was spun off in 1999 in a merger with BAE, generating £1.5 billion for GEC. The remaining telecommunications business was renamed and re-listed as Marconi (Dixon, 1997). Despite being headquartered in Pennsylvania in the US, the company could not be quoted in the US for reasons linked to previous issues with the US Foreign Corrupt Practices Act. Simpson's ambition to broaden the company's product range and geographic presence thus had to be accomplished with the use of its war chest of cash, accumulated from its divestment of defense, transport and power assets.

In 1999, Marconi purchased Reltec, a NYSE-listed company for \$2.1 billion. The US company supplied access equipment to North American incumbent telecom operators and its 1998 revenues were \$1 billion. This represented a 20% increase on the previous year but the company's sales and profits had been falling, along with its share price. Later in the same year, Marconi acquired another US firm, Fore that was quoted on Nasdaq and that had 34% of the enterprise ATM switch market. Marconi's payment of \$4.5 billion in cash was considered generous, in particular as the UK company promised to buy out all outstanding stock options for company employees, whether vested or not. Seven of the top Fore executives, including the CEO, subsequently left the company.

Marconi was listed on Nasdaq in October 2000 and announced an executive stock option plan with a vesting price of twice the share price at the time to focus management on the goal of doubling the value of the firm in a five-year period. In 2001, Marconi was named as the sole supplier of a £2 billion optical networking contract with BT but the company was already grappling with a falling share price and was announcing lay-offs and plans to accelerate outsourcing. During this period, Marconi found itself in difficulty as it planned to sell its medical unit to Philips at the same time as it needed to make a profits warning. Trading of Marconi shares had to be suspended for a day between the announcement of the \$1.1 billion deal and a board meeting to be held later in the day. A second profits warning followed rapidly and the company was expelled from the FTSE 100 in September 2001 as the price of its shares had fallen below 38 pence. Having written-down its acquisitions, its net value was practically nil and the company's main challenge was reducing its debt of £4.4 billion.⁵ Further financial difficulties emerged from an earlier decision by the company to seek insurance against potential liabilities on an employee share option plan by entering into a forward contract to buy its own shares at a price believed to be around £8 per share. A public relations problem also had to be addressed as shareholders objected to payoffs of £1 million for Simpson and £300,000 for Sir Hurn (Barker and Pretslik, 2000).

In December 2001, Marconi 'sold' its six-month old components division to Bookham Technology in an all-share deal that gave Marconi 9 per cent in Bookham, valued at \$29 million. The deal did not reduce the company's debt but Marconi was no longer responsible for the funding of the component's business's cash burn, estimated at \$50 million per year (Barker and Hunt, 2001). In January 2002, it issued a third profits warning and announced a further 4,000 job cuts.⁶ Ericsson finally acquired the majority of the assets of Marconi for £700 million in October 2015. 6,671 Marconi staff were transferred to Ericsson and the remaining 2,093 were transferred to 'telent plc', a company formed from the remaining UK service business in January 2016.

John Mayo's defense of Marconi's strategy was published in the Financial Times in 2002, and he explains that there was a plan to sell the company when the shares were priced at £8 and rising. The proposal was rejected, according to Mayo (2002), by a board member who argued "We did not give up on the beaches of Dunkirk, and we are not going to give up now, in an apparent reference to Siemens. Another Financial Times columnist, however, rejected Mayo's argument defense of management strategy, as the company had gone from a net worth of £4.5 billion to technical insolvency. In relation to the admission that not selling itself was Marconi's biggest mistake, Plender

⁵ "Marconi's Shares Plummet 28% Following Warning", *The Wall Street Journal*, 6 September 2001.

⁶ "Marconi To Lay Off Another 4,000", *Light Reading*, 15 January 2002.

(2002) concluded “it is not just that Mr. Mayo’s proposal for selling the company strikes one as unrealistic. The underlying assumption that companies were for buying and selling on the basis of bubble-distorted price signals was shareholder value gone mad. In effect, this ex-investment banker wanted to build a corporate strategy on the greater fool theory – the notion that there would always be another sucker to take Marconi off the hook. When ideas of shareholder value are so far divorced from business reality, heaven help us”.

Siemens

Siemens was established in Berlin in 1847 to construct the first European long-distance telegraph line. In experiments run in order to improve the efficiency of telegraphy operations, one of the company’s founders, Werner Siemens, discovered the dynamoelectric principle in 1866 (Feldenkircher, 1987). The company went on to develop into one of Germany’s leading industrial concerns and, by the end of the 20th century, it was present in eight areas of what it termed “life technologies”: energy, industry, information and communication, transportation, health care, lighting, components and financing and real estate. In 1998, the company had revenues of €60 billion, positioning it only behind GE and IBM for that year. Its 440,000 employees made it Germany’s second-largest employer. Its CEO at that time, Heinrich von Pierer, had already sold off businesses worth €2 million and reduced the work-force by 17% but he was still being compared unfavourably to Daimler Chrysler’s CEO, Jürgen Schrempp, who had initiated significant cost cutting measures in another leading German firm. Siemens announced it would divest itself of 50 of its 200 business fields to narrow the focus of the firm with half the turnover based on two areas: telecommunications and industry. Subsequently the importance of the “Information and Communications Systems” segment rose from 37% of turnover in 1998 to 44% in 2003.

The company began a series of acquisitions in early 1999 to enter the high-speed data networking area. Castle Networks was acquired for \$300 million, Argon Networks for \$240 million and Redstone Communications was for \$500 million. These companies bring products and expertise in packet/circuit conversion hardware, IP routing and terabit routing respectively (Spectrum Telecommunications Report, 1999). In March 1999, a new US unit, Unisphere Solutions Inc, was created from the first two of the above acquisitions, as something that will ‘help to transform the culture of the whole group’ (Waters, 1999). Unisphere Solutions also encompasses an equity stake in Accelerated Networks acquired for \$300 million and integrates three other Siemens’ units in Florida, Ontario and Germany (Boswell, 2000). However, the new business initially was made up of only 500 employees and sales amounted to \$200 million, which is only a fraction of the \$8.5 billion turnover of industry leader, Cisco. Siemens announced that \$1 billion had been earmarked to back the new US venture and that a further \$400 million would be used to fund further investments (Waters, 1999). Redstone Communications was the first of Unisphere’s acquisitions to date. The company serves service providers with infrastructure to support the service and transport requirements of the last five miles and stresses its ability to facilitate the intersection of the existing infrastructure with the new data-oriented and Internet markets, without the ‘restrictions of protecting an installed base or forcing customers into legacy architectures’.⁷ In April 2000, Siemens announced that it will float Unisphere and the CEO stated “Unisphere is our key investment in high-growth IP technology. We will follow the rules for start-ups in the U.S. and let the employees share in their company's success through stock options.”⁸

Already in 1999 at the corporate level, Siemens had announced that its goal for 2001 was to achieve a positive economic value added (EVA) where investments more than covered the cost of capital. Remuneration for senior level management was linked to EVA performance, with the fixed

⁷ www.unispheresolutions.com

⁸ Siemens press release, 27 April 2000

portion of the salary of top management representing only 40% of the total and up to 60% accounted for by a combination of short term and long term EVA-linked bonuses. The final component of managers' salaries was linked to stock options.⁹ Siemens also unveiled a program to buy back €1 billion of its shares as 'the improved cash flow generated by higher earnings from Operations and the net cash provided by divestments will make it possible to implement the stock buy-back program approved at the annual shareholders' meeting in February.'¹⁰

Nonetheless, in the ICT segment, doubts were expressed about the company's ability to catch up with rivals. A Goldman Sachs report, for example, concluded that "without significant acquisitions, the information and communications group may find it hard to compete in this market in the long term". Siemens expressed confidence in its 'string of pearls' approach to acquisitions but did not rule out a major acquisition should the opportunity arise (Boston, 2000). The revenue of Siemens' ICT division grew from \$13 billion in 1996 to \$23 in 2001 but ground to a halt with the crisis. When revenues fell to \$17 billion in 2005, the company decided to enter into a joint venture with Nokia and Nokia Siemens Network (NSN) was created. The joint venture did not manage to generate profits, however, and it was refocused on mobile broadband in 2011, following the 2010 acquisition of Motorola's mobile infrastructure business and the announcement that one in three employees were destined for redundancy. Difficulties continued in a challenging operator market and, in 2013, Nokia became sole owner of NSN for €1.7 billion and Siemens' role in the telecommunications industry came to an end, 127 years after it had begun.

Nokia

Although Nokia's entry into the telecommunications market is far more recent than Siemens, it managed to become the world's leading supplier of mobile phones in 1998. Nokia's origins lie in a far more traditional industry, the paper pulp industry, where the company's founder began his business in 1865. The firm diversified into rubber, cables and television and, by the 1970s, the Finnish company had become an industrial conglomerate, albeit a relatively small one compared to Siemens and GEC. In the 1980s Nokia made a failed attempt to enter the micro-computer market and pulled out during the Finnish recession of the early 1990s. In 1987, however, the company had entered the telecommunications market and resolved to refocus, Nokia made an enlightened decision in 1992 that it was the mobile communications sector that offered the greatest potential for the company to grow. The firm decided to leverage a presence on Nasdaq to enhance its growth potential and, after a number of years of heavy investment, profits, revenues and share price grew exponentially. Revenues for its iconic 3310 model was launched in 2000 and Nokia's market share grew to 35% of the global market. Although competition was intensifying and the global crisis hit the networking side of the business as operator capex dried up for a number of years, Nokia dominated the mobile handset market globally and its revenues grew to an astounding \$74 billion in 2008. At this point, Nokia represented 57% of the total sales of the remaining three European vendors and one quarter of the revenues of all firms in the company under review. Unfortunately for Nokia, a US firm that was not involved up until then in the mobile market had already begun to change the landscape dramatically. One of Nokia's strengths was its integrated hardware and software, based on the Symbian platform, and its ability to address developing markets with a range of affordable mobile phones. Ironically, these strengths blinded Nokia in part to the disruptive potential of Apple's high-range iPhone built on its iOS platform. As with Motorola, Nokia lost too much time accepting that Apple's smartphone had changed the rules of the game (Vuori and Huy, 2015) and its large organization did not manage to react in a timely way. Nokia replaced its CEO, Olli-Pekka Kallasvuori with Stephen Elop, who joined the firm from

⁹ Siemens press release, 3 December 2000

¹⁰ Siemens Press release, 27 April 2000 on www.siemens.com.

Microsoft's business division. In 2011, he announced a partnership with his former employer and Nokia's Symbian software was replaced by MeeGo from Windows Phone. In 2012, the firm announced 10,000 layoffs and was overtaken by Samsung, using Google's Android operating system, as the world's leading mobile phone manufacturer. As mobile phone revenues continued to drop significantly, Nokia sold to business to Microsoft in September 2013 for \$7.2 billion. For Microsoft, the deal was not successful as it did not achieve significant penetration of the mobile market, and Microsoft wrote off \$7.6 billion in 2015, in addition to approximately \$800 million to cover the cost of laying off 7,800 employees. In 2015, Nokia used its shares to acquire Alcatel-Lucent for \$16.6 billion and reposition itself clearly as a challenger to Ericsson and Huawei in the communications equipment sector (Le Maistre, 2016).

In the midst of the dramatic events that Nokia experienced over the decade 2000-2010, the company also decided that it would engage in share repurchases. Between 2003 and 2008, Nokia repurchased \$24 billion of its own shares, with an average of \$5 billion in buybacks between 2005 and 2008, precisely when the firm's future was in danger from the, as yet under-appreciated disruption about to emerge from Cupertino.

Alcatel

In France, a similar role played by Henrick von Pierer at Siemens was undertaken by Serge Tchuruk at Alcatel, who took over as CEO of the loss-making conglomerate, Alcatel, in 1995. The company had just announced a historic loss of €4.9 billion. Tchurk came to the firm with a strong reputation of having turned around Total, the French oil company. At this point, telecommunications generated 41% of the company's turnover with the rest coming from the energy division, Alcatel-Alsthom. Alcatel's corporate origins were in the electricity sector, as the company was originally founded as Compagnie Générale d'Electricité in 1898 when two French regional electricity suppliers merged. Alcatel's international expansion was kick-started by the commercialization of its pioneering E10 switch, developed in the 1970s in close collaboration with the research laboratory of the French telecommunications administration. In 1986, the firm benefited from the break-up of the struggling US-based global equipment manufacturer, ITT, when they entered into a joint venture, via a \$577 million investment that enabled Alcatel to gain control of its European operations. Nationalized by the newly-elected French government of François Mitterand in 1982, the company was privatized again in 1987 in a large fund-raising exercise during which US institutional investors became shareholders of the company for the first time. The name Alcatel-Alsthom was adopted in 1991. Under Tchuruk's reign, the company began to focus on telecommunications and was renamed Alcatel in 1998 while the energy business went to market separately as Alsthom, a power generation, energy distribution and rail transportation business. Other disposals during these three years included media and publishing activities, a variety of low-technology cable businesses and even a wine-producing chateau in the Bordeaux region (Owen, 1997).

Alcatel's primary objective from 1998 was to develop its business in the US. Only 5% of its turnover came from this leading global market, compared to 8% for German competitor Siemens. Alcatel had already purchased Rockwell Network Transmission in 1991 for \$625 cash but in 1998, it used its American Depositary Receipts (ADRs) to acquire DSC Communications for \$4.7 billion. Unfortunately, American shareholders abandoned the stock as a result of the acquisition and the company's share price fell by almost 40% in one day (Owen, 1998). In recognition of the negative perception of what was viewed as an unwieldy and old-fashioned European conglomerate, Alcatel's 1999 annual report stressed the company's commitment to shareholder value. However, during 1998 and 1999, Alcatel's next four US acquisitions were cash-based transactions, including the \$2 billion purchase of Xylan. With this and three other smaller acquisitions, Alcatel acquired firms with valuable US customers and IP capabilities. In September 1999, the company was again able to use its ADRs to

purchase Genesys, a CRM enterprise specialist for \$1.5 billion. In 2000, Alcatel acquired Newbridge Networks in Canada for \$7.1 billion in shares, a company whose strategic alliance with Siemens was part of the German firm's strategy to develop IP capabilities. An Indian engineer, Krish Prabhu, who had come to Alcatel as part of the Rockwell acquisition, became COO of the French company and was named president and COO of the American subsidiary in 1998. His role was to smooth the post-integration of the acquisitions and ensure that employee turnover did not surpass that of competitors. A stock option program was introduced in 1998 and expanded in 2000 and Alcatel's board voted a share repurchase program. The downturn however meant that neither significant distribution of options nor buybacks of shares were going to occur.

Throughout the focusing period of the late 1990s and the Internet crisis of the next five years, Alcatel's initial weakness in North America, and its late arrival to the mobile networking market was partly compensated for by its strong optical networking portfolio and its leadership in the ADSL segment that allowed operators bring higher speed Internet to homes and businesses (Boegaert et al, 2000). It also benefited to a greater degree than its close competitors from the growth of the Chinese market as it was present through Shanghai Bell, a joint venture between ITT and the Belgian state that Alcatel had acquired fully in 2001 for a sum estimated between €80 and €106 million. With on-going disposals in other areas, such as residential phones and the spin-off of the cable business to create Nexans, Alcatel was able to survive intact, despite losses of \$4.4 billion in 2001, \$4.9 billion in 2002 and \$2.3 billion in 2004. When the merger with Lucent was first discussed in 2001, Lucent had booked a loss of \$14.2 billion and went on to lose a further \$11.6 billion in 2002. Both companies had comparable revenues of approximately \$30 billion in 2000 but, by 2006, Lucent's revenues had collapsed to \$8.7 billion, while Alcatel's were over \$16 billion. Despite Serge Tchuruk's controversial statement to the press in 2001 that Alcatel intended to become "fabless", Alcatel still had almost 60,000 employees in 2005 while Lucent had less than 30,000. In the middle of this difficult period of restructuring, Alcatel had managed to secure what was to prove to be a highly-significant acquisition in 2003. It purchased a 90-person start-up, TiMetra Networks that competed in the IP/MPLS edge routing segment and replaced its in-house development of an optical router to focus on the TiMetra product, launched in 2004 as the 7750 SR-7. TiMetra's president and CEO, Basil Alwan, went on to play an important role in building one of Alcatel's most successful growth businesses where it competed successfully with US vendors, Cisco and Juniper.

Alcatel finally acquired Lucent in 2006 and the \$16.2 billion revenues of the combined company positioned it ahead of NSN's \$15.8 billion and only slightly behind those of industry leader at the time, Ericsson with \$17.2 billion in revenues. Serge Tchuruk was Chairman of the Board of the new company launched on the NYSE and Euronext on December 1 2006. A combination of post-merger integration difficulties (Le Maistre, 2007), Lucent's failing US business (Lazonick and March, 2011) and intense competition with emerging Chinese suppliers led to a decline in revenues for the merged group and further profits warning. The firm struggled to build relationships with customers across the globe as a full-service supplier, in part as it lacked a clear corporate identity and was suffering from managerial infighting, rumoured to rise to the highest level. It also failed to establish a clear roadmap to move from 3G to 4G technologies and rivals Ericsson, Huawei and ZTE gained market share in this segment. With losses rising from \$0.2 billion in 2006 to almost \$6 billion in 2007 and over \$7.2 billion in 2008, CEO Patricia Russo, who had come from Lucent, was replaced by Dutchman Ben Verwaayen who had been at the head of British Telecom. Losses declined initially under his leadership and Alcatel-Lucent actually made profits of over \$1.4 billion in 2011 but difficulties persisted. In 2012, the company was obliged to use its 29,000 patents as collateral to raise €2 billion in loans from Goldman Sachs and Credit Suisse. Verwaayen was replaced by yet another new CEO, Michel Combes, in 2013. Combes had been CEO of SFR, a leading French mobile operator and he streamlined the organization and sold it to NSN in April 2015. Nokia took advantage of the

acquisition to rename its communications equipment business simply Nokia and the name, Alcatel, was now part of French corporate history.

Ericsson

In contrast to the other European companies in the sample, Ericsson's corporate development over the past twenty years has been relatively stable. Created in 1878 by Lars Magnus Ericsson, the Swedish company has managed to maintain its global leadership in the mobile infrastructure market since 2G and has successfully diversified into managed services. Ericsson initially repaired telephones from Bell Telephone Company and Siemens before designing a higher-quality version that he commercialized successfully in Scandinavia, along with the necessary equipment. Having rapidly saturated nearby markets, the company had begun to internationalize by the end of the 19th century and, in addition to the UK and Russia, customers Australia and New Zealand adopted Ericsson technology. The company also moved into Central and South America and China. When Ericsson stepped down in 1901, his company was already a multinational. The Swedish Wallenberg family became owners of the company in 1960 when it bought its shares from ITT. The US-based equipment manufacturer had been building up a financial interest in the company since the 1920s when it was under the control of a Swedish financier but was prevented from taking it over by a clause limiting ownership by foreign investors to under 20%.

Throughout the 20th century, Ericsson crossbar switching system, the AXE, was adopted worldwide and the company's early lead in mobile phones gave it a central role as the GSM mobile standard led the mobile revolution from a European base from the mid 1990s. While its capabilities in the mobile networking side of the business were clear, the company struggled to maintain market share in the more consumer-dominated mobile phone handset market and was outpaced by Motorola and Nokia. When the downturn hit in 2000, the company was forced to choose. In 2001, Ericsson spun off this activity in a joint venture with Sony Corporation to produce mobile phone terminals, under the Sony-Ericsson brand. In 2011, Ericsson sold its part of the joint venture to Sony for €1 billion.

During the Internet boom in the second half of the 1990's, Ericsson realized that it needed a greater presence in IP networks and a number of US acquisitions were conducted. To survive the downturn, Ericsson laid off 53,000 employees between 2001 and 2003 and it raised over \$3.3 billion in a rights issue in 2002. Its restructuring and its core strengths in 3G networking technologies meant that the company was well-positioned to benefit from the growth of mobile internet infrastructure that followed the launch of the iPhone in 2007 and the rapid global diffusion of smartphones. Ericsson continued its attempts to build a US IP presence during this phase and, in 2006, it acquired San Jose-based Redback Networks for approximately \$1.9 billion in cash. Redback had 800 employees at the time, 500 of whom were engineers and its routers to manage IP-based data, voice and video services had 700 carrier customers, including fifteen of the world's top twenty carriers. The acquisition is generally considered to have been a failure, however. Ericsson's launched its next-generation SSR 8000 range of core routers in 2011 but has not managed to acquire any significant market share or challenge the leaders in the segment Cisco, Nokia (that acquired Alcatel-Lucent in 2015) and Juniper.

Since 2012, Ericsson has also made a series of acquisitions to build its Broadcast and Media services unit. This began with the acquisition of the broadcast services division of French company, Technicolor and continued with the purchase of Microsoft's MediaRoom business in 2013. In 2014, there were three significant acquisitions: Azuki Systems in the US, Fabix in the US and Israel and Red Bee Media in the UK. Envivio, quoted on the American Nasdaq stock market, was acquired in 2015 for \$125 million to add capabilities in software-defined and cloud-based architectures for video processing. By 2015, the company had thus become a significant provider of images and metadata to TV channels with over 2,500 employees involved in delivering millions of hours of programming, with captions in different languages, often provided for live broadcasts. However, critics did not see

how a growing presence in what is essentially a maturing business was going to reposition Ericsson in a digital landscape.

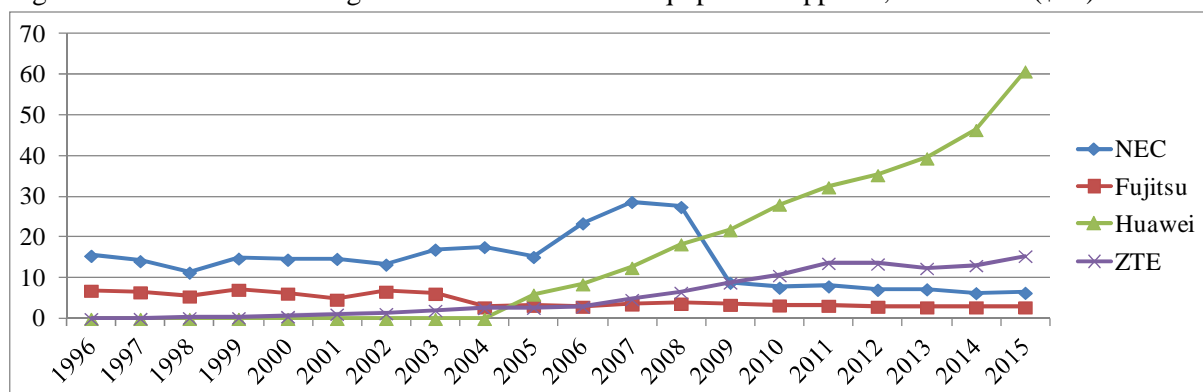
Although Ericsson did experience a roller-coaster moment when revenues rose to \$29 billion in 2000 and then tumbled to \$16.4 three years later, it appeared to have taken the necessary radical cost-cutting and layoffs. When the market took off again, Ericsson was well-positioned to move into the services area for mobile providers worldwide and revenues began to rise back to previous levels. Between 2003 and 2013, Ericsson engaged in a successful 10-year transformation of its business focus from selling hardware to selling services and software. In 1999, 73% of the company's revenues came from hardware and this percentage had fallen to 40% by 2008. In 2013, only 34% of revenues were linked to hardware and almost two thirds were from services and software (Saunders, 2015). In 2013, revenues were almost \$35.5 billion and profits were over \$1.8 million. Since then, however, revenues have been suffering from the slow-down in operators' capex and profits are under pressure from intensifying competition.

In late 2015, a strategic technology and commercial alliance was announced with Cisco whereby Ericsson resells Cisco routers and Cisco leverages Ericsson's traditional strengths in radio and mobility. On January 16 2017, Ericsson and Cisco announced their first major joint contract to transform the network of Vodaphone Hutchison Australia.

2.3 Non-financialized firms from Asia

In 1996, two Japanese firms constituted virtually the entire volume of revenues for the Asian group of suppliers, and Asia's revenues in the communications equipment sector made up only 16% of the total revenues for the sixteen firms under study. NEC's revenues from its "Communication Systems and Equipment" division accounted for more than two-thirds of these revenues. By the end of the period studied, however, the communications equipment revenues of both these Japanese firms had fallen and it was two Chinese communications suppliers who contributed 90% of the \$96.8 billion revenues of the Asian firms. With Huawei's rapid growth, the group of four Asian firms represented 42% of total revenues in 2016 for the all of the global companies in our study.

Figure 7: Revenues of leading Asian communications equipment suppliers, 1996-2016 (\$bn)



NEC and Fujitsu

Nippon Electric Company was co-founded in 1899 by the US firm, Western Electric, along with Takeshiro Maeda and Iwadare Kunihiro, a former employee of Edison in New York. Initially focused on manufacturing telephones and telephone exchanges, the company diversified into the production of microwave radio and underwater cable transmission systems, as well as semi-conductors and integrated circuits. From the 1960s, the firm intensified its internationalization and diversified further

into other telecommunications technologies such as satellites and mobile phones and downstream in the IT value chain with a range from PCs to supercomputers. The company's name was changed to NEC in 1983, and in 1996 the company acquired Packard Bell and retained the brand for its PCs and servers in the North American and European markets. In 1996, communication systems and equipment revenues represented one-third of the firm's overall sales of over \$41 billion. In 1996, foreign investors made up 15% of NEC's shareholders.¹¹

Fujitsu was created in 1935 when Fuji Electric, spun off its communications division. Fuji Electric was created in 1923 as a joint venture between a Japanese electricity company and Siemens. Fujitsu expanded its international presence by acquiring a majority stake in the British PC manufacturer, ICL, in 1990 for approximately \$1.3 billion and obtained full ownership of US mainframe manufacturer, Amdahl in 1997 for \$0.8 billion. In 1999, it entered into a joint venture with Siemens Computers, and it bought out the operations in 2007. In 1996, revenues in the "Communications systems" division represented slightly over 16% of Fujitsu's total revenues, with "Computers & information processing systems" representing by far the majority of revenues for the group, at 64% of the total. 72% of the firm's revenues were from Japan.

Along with Hitachi and Oki Electronics, both companies were part of four "family firms" of the Japanese Ministry of Communications (MOC), and they were encouraged to compete with each on quality in order to gain orders (Kushida, 2011). After World War II, this role was taken on by Nippon Telephone and Telegraph, in close collaboration with the Japanese government, and the national suppliers were encouraged to avoid imported equipment and to meet specific Japanese technology standards (Fransman, 1995). Kushida (2011) describes Japan's choice of proprietary digital cellular standards as typical of the frame of mind that led to a "Galapagos" effect, whereby Japan's vendors were isolated from global competition, at the same time as they were subject to strict competition in the domestic market and pushed to develop sophisticated products, but not products that could succeed on a global scale.

In 2016, both NEC and Fujitsu remained very dependent on Japan. The domestic market represented respectively 79% and 60% of their revenues for fiscal 2016. For NEC, the telecom carrier segment represented 25.5% of group turnover. For Fujitsu, its telecommunications sales reported in its annual report only amounted to 5% of the group's total revenues for 2016. Each company has strengths in particular niches: Fujitsu in optical transport in the US and Japan for example and NEC in subsea cables, SND/NFV and mobile backhaul technology. Neither, however, appears to have developed the capabilities needed to position themselves as innovators on a global scale. Their dependence on the relatively stagnant Japanese markets is further weakening their competitive positions and they are likely to continue as strong niche players in certain technological fields rather than develop into full service vendors of communication equipment worldwide.

Huawei

Shenzhen-based Huawei was established in 1988 by Ren Zhenfei as a distributor of imported telecommunications equipment. Huawei began by selling imported telephone call switches before developing its own low-tech, low-cost switching product. It invested heavily in R&D to develop its own digital switch, the C&C08 that went on to dominate the Chinese telecom market (Athreye & Chen, 2009). In the early 1990's, in order to avoid head-to-head competition with stronger rivals, Huawei focused on remote rural China, allowing it to build a base from which it could later penetrate larger cities and global markets (Li, 2006).

Huawei's low-cost engineering – as opposed to low-cost manufacturing – is considered to be the secret behind its initial competitive advantage. By 2005, almost half of Huawei's employees were

¹¹ <http://www.nec.com/en/global/ir/library/annual/1996/info/info.html>

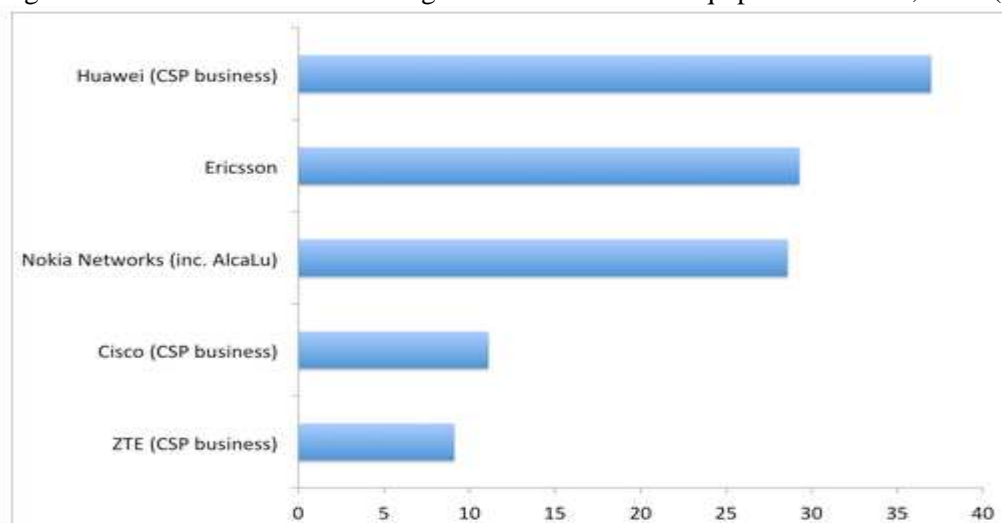
involved in R&D and 60% of them held a master's or Ph.D. degree (Tao and CHunbo, 2015) With Chinese salaries one-third to one-fifth those of their Silicon Valley counterparts, Huawei could mobilize a cost advantage in the marketplace (Normile, 2005). Huawei has been particularly successful, however, in penetrating other international markets and its non-domestic sales overtook its Chinese revenues in 2005. It partnered with IBM to overhaul its management structure between 1998 and 2003, formed a joint venture in data networking with 3Com in 2003 and another with Siemens in 2005 to develop 3G/TD-SCDMA and with Motorola in 2006 for UMTS development. Huawei has only made a small number of acquisitions in its expansion.

Unusually, Huawei's ownership is in the hands of its employees. Ren Zhengfei has been the president of the company since 1987 and he retains approximately 1.4% of ownership, with the rest held by the "Union of Huawei Investment & Holding Co." which involved 81,144 employees in December 2016. The company claims that this employee ownership "effectively aligns employee contribution with the company's long-term development, fostering Huawei's continued success" (Huawei Annual Report, 2016, p.99). Huawei does not plan to go public as it believes that "doing so would effectively dismantle their profit-sharing plan, hurt morale by creating inequality, pressure the company to think short-term, and curtail innovation and growth – which are of high value within the telecom industry" (De Cremer and Tao, 2015). As the ownership scheme is only open to Chinese employees, however, Huawei piloted a supplementary profit-sharing and bonus program in 2014. As a result of this "Time-based unit plan" (TUM), all employees in receipt of "units" benefit annually from an amount allocated annually by the group to the plan for a period of five years. In 2016, the plan amounted to over 10% of the total cost of salaries, benefits and retirement costs, up from 8.8% the previous year.

In 2016, Huawei's carrier business represented over 55% of its turnover and enterprise 7.8%. The consumer business had grown considerably, however, with the international success of the firm's handsets and it had grown to represent 34.5% of turnover. China still made up over 45% of revenues, with EMEA next at 30%. The Asia-Pacific region outside of China corresponded to almost 13% of revenues and the Americas less than 8.5%.

In the carrier market, Huawei is now the leading global vendor (Figure 8) and its CEO Eric Xu—one of three CEOs who rotate every six months—was reported as announcing that it could double its revenues from carriers and enterprise to \$80 billion in 2020 (Clark, 2016).

Figure 8: CSP revenues from leading telecommunications equipment vendors, 2015 (\$bn)



Source: Iain Morris (2016), "Huawei: New King of the CSP Market", *Light Reading*, 4 July.

The performance of Huawei is particularly striking, given that its goods and services have not been available in the US market since 2012, when a report of the Select Committee on Intelligence of the US House of Representatives concluded that Huawei and ZTE posed threats to national security.¹² The report concluded that “The United States should view with suspicion the continued penetration of the US telecommunications market by Chinese telecommunications companies” and recommended that their equipment be excluded from US government systems. In addition, “private-sector entities in the US are strongly encouraged to consider the long-term security risks associated with doing business with either ZTE or Huawei for equipment or services. US network providers and systems developers are strongly encouraged to seek other vendors for their projects. Based on available classified and unclassified information, Huawei and ZTE cannot be trusted to be free of foreign state influence and thus pose a security threat to the US and to our systems” (p. 53).

ZTE

Despite their shared Chinese origins and comparable internationalization paths, ZTE and Huawei’s corporate histories are different. ZTE was initially founded as Zhongxing Semiconductor Company in 1985 before becoming Zhongxing Telecommunications Equipment (ZTE) Company in 1993. The original company was founded by investors linked to the Chinese Aerospace ministry and ZTE was founded as the first example in China of a combination of state-owned and private firms. It became publicly traded after its 1997 IPO on the Shenzhen stock exchange, followed by another public offering on the Hong Kong stock exchange in 2004. This influx of capital helped ZTE to invest in both R&D and international expansion and it was particularly successful in winning orders for CDMA networks (Athareye and Chen, 2009). ZTE has not engaged in significant repurchases and its dividend has rarely gone above \$300 million.

In 2016, over 58% of ZTE’s revenues came from the carrier segment, with a further 33% coming from its consumer business and just under 9% from the segment it terms government and corporate business. Almost 58% of its revenues were still from China while Asia, outside of China accounted for another 14.4%. Europe, Americas and Oceania made up over 22% of 2016 revenues and Africa slightly over 5.5%

3. Financialized and non-financialized firms in the communications equipment industry

The previous section outlined the technological and market dynamics in the mobile equipment segment. These are the dynamics that will form a foundation for the future direction of the communications equipment sector in a 5G world with sensors linked to IoT applications drawing heavily on the networks capabilities. The opportunities are significant and the potential for firms to take advantage of them will depend on their ability to invest in developing a variety of long-term capabilities to serve the emerging needs of carriers, businesses and consumers. In this section, we examine how the performance of the firms presented in part 2 can be considered to be influenced by financialization over the four periods of the study. From this analysis (Table 2), we compare the long-term performance in terms of revenues of the firms that are classified as financialized and those that are classified as non-financialized.

¹² “Investigative Report on the US National Security Issues Posed by Chinese Telecommunications Companies Huawei and ZTE”, A report by Chairman Mike Rogers and Ranking Member C.A. Dutch Ruppersberger of the Permanent Select Committee on Intelligence, US House of Representatives, 112th Congress, October 8, 2012.
[https://intelligence.house.gov/sites/intelligence.house.gov/files/documents/huawei-zte%20investigative%20report%20\(final\).pdf](https://intelligence.house.gov/sites/intelligence.house.gov/files/documents/huawei-zte%20investigative%20report%20(final).pdf)

For the purposes of comparison, the sixteen companies presented in part 2, were examined for evidence of financialization in terms of making significant use of buybacks during any of the four periods examined or in terms of making strategic decisions about entering or exiting businesses based on primarily financial concerns.

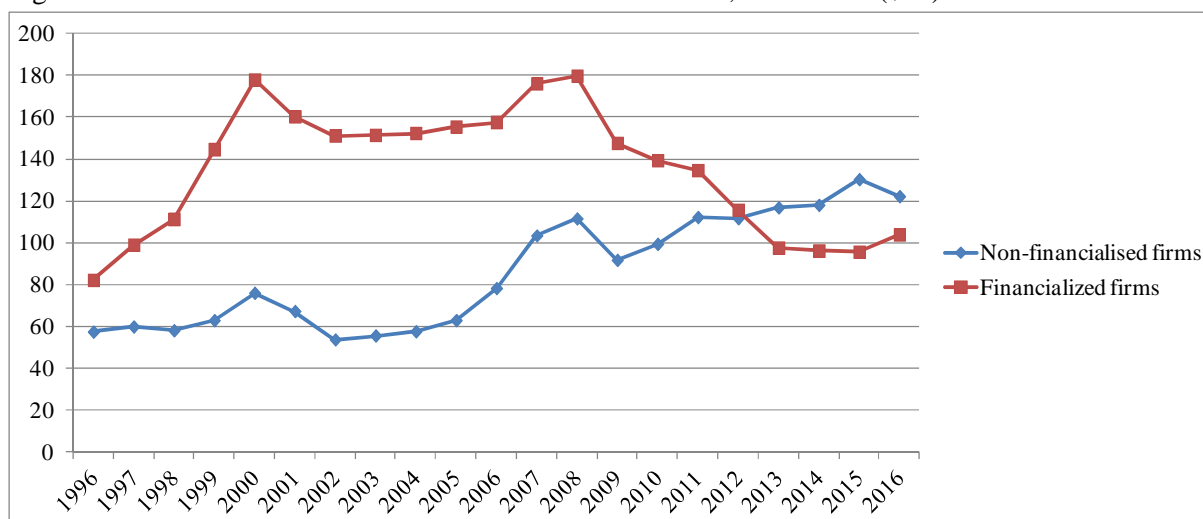
Table 2: Comparison of level of influence of financialization on leading communications firms

	Period 1 1996-2000		Period 2 2001-2008		Period 3 2009-2013		Period 4 2013-2016		Financialized (√)
	influence	buybacks	influence	buyback	influence	buyback	influence	buyback	
NA firms									
Nortel									√
Lucent									√
Cisco									√
3Com									√
Motorola									√
Qualcomm									√
Juniper									√
EU firms									
Marconi									√
Ericsson									
Nokia									√
Alcatel									
Siemens									√
Asian firms									
NEC									
Fujitsu									
Huawei									
ZTE									

Of the total sixteen firms in the study, ten were considered to have become more or less financialized during the period under study. These include all seven of the US firms and three of the European firms. None of the four Asian firms were considered to have adopted practices that were linked to financialization and none of them engaged in share buybacks.

The performance of the two groups of firms, ten financialized and six non-financialized, is compared in terms of revenues (Figure 9). For many years, the performance of the financialized group of firms is superior to that of the non-financialized firms, but this situation changes in 2012 and the revenue of the remaining non-financialized firms are higher than those of the remaining financialized firms.

Figure 9: Revenues of financialized v non-financialised firms, 1996-2016 (\$bn)



Source: Capital IQ, Factset, Annual Reports

The improvement in the relative performance of the group of non-financialized firms since 2008 is largely due to the growth in revenues of Huawei. Its revenues have grown from \$18 billion in 2008 to \$75 billion in 2016, representing respectively 16.5% and 61.5% of the total revenues for the total of all firms remaining in the non-financialized group. The financialized group improved its total revenues in 2016, as Nokia, classified as financialized, acquired Alcatel-Lucent, classified as non-financialized, and thus incorporated the latter firm's revenues of approximately \$16 billion.

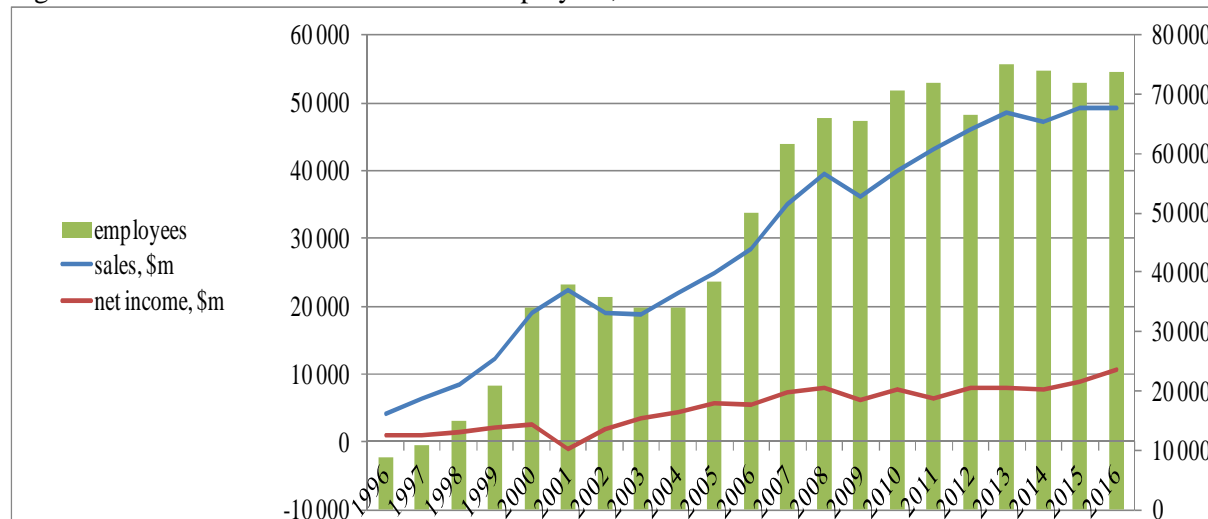
This comparison over a long time-period of two different groups of firms, defined by the level of influence that financialization has had on their investment decisions, highlights how a financialized group of firms can appear to be generating superior performance for a relatively long period. The financialized group clearly outperforms the non-financialized group from 1996 until 2007 when the performance of Huawei starts to increase the pace of growth of the group of non-financialized firms. From 2007 in the group of financialized firms, the revenues of both Motorola and Nokia begin to fall with their loss of market share in the mobile handset market. Huawei's success, however, indicates that there is potential for growth over this period. To understand how non-financialized firms such as Huawei managed to capture this growth, while financialized firms such as Cisco did not, the following section will consider the influence of the social conditions of innovative enterprise—financial commitment, organizational integration and strategic control—on the investment decisions and competitive performance of the two different types of firms. For the tables in this section, only firms identified in part 3 as significant for the future dynamics in the industry are included in the two groups. For financialized firms, the group thus includes Cisco and Nokia and for non-financialized firms, this includes Ericsson, Huawei and ZTE. Where relevant, qualitative and quantitative information relating to the other firms from the initial group of sixteen will be included in the discussion and information regarding new entrants will also be used where it helps to highlight how financialization may be influencing the strategic decisions of the firms studied.

3.1 Financial commitment

The significant growth in share repurchases on the part of financialized firms over the period is considered to be a potential explanation for a reduction in the ability of the firms to accumulate the necessary capabilities to transform their organizations at times of significant technological and competitive evolution. While Cisco remains a successful networking equipment company (Figure 10), it is the company in the communications equipment sector that has most actively engaged in the

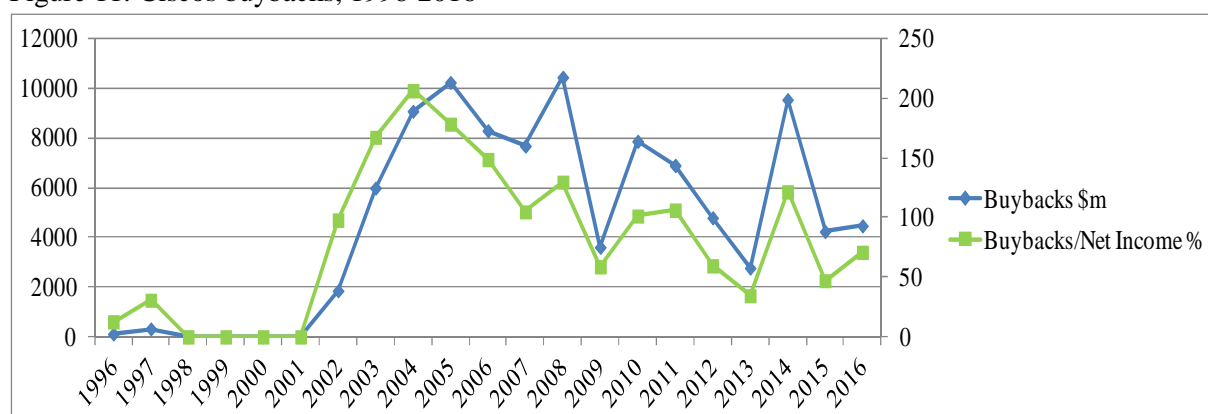
practice of buying back its own shares, often to a degree that exceeds its profitability (Figures 11 and 12). As we have seen, at the beginning of the 2000s, it had aspirations to become a major competitor in infrastructure equipment. The question is how its massive buyback activity affected its achievement of those aspirations.

Figure 10: Cisco's sales net income and employees, 1996-2016



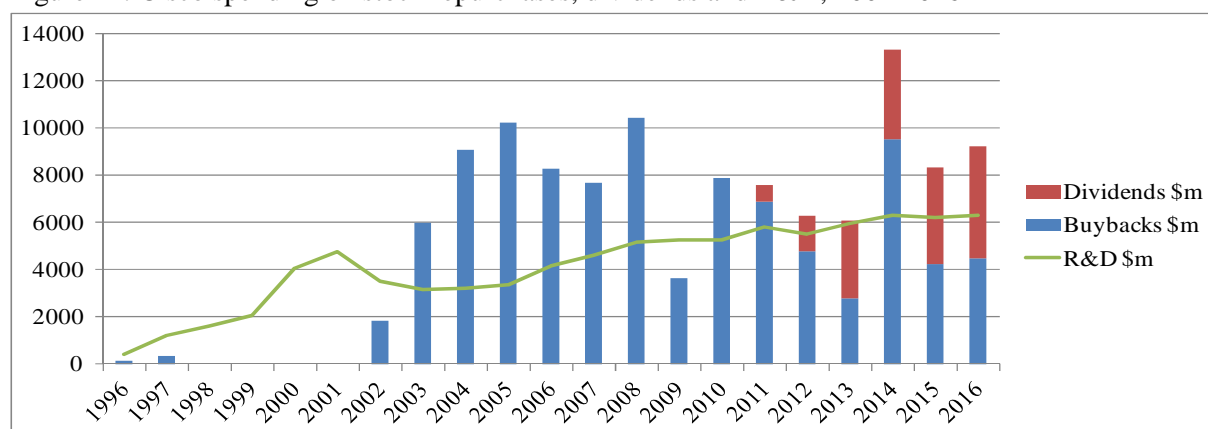
Source: Capital IQ, Cisco 10-K filings

Figure 11: Ciscos buybacks, 1996-2016



Source: Capital IQ, Cisco 10-K filings

Figure 12: Cisco spending on stock repurchases, dividends and R&D, 2001-2016



Source: Capital IQ, Cisco 10-K filings

Cisco was the company that was most notably accumulating cash in the late 1990s and the 1999 Spectrum Report cited in the introduction points out that it had “become more like a financial institution than a data networking and telecom equipment manufacturer” (Spectrum Telecommunications Report, 1999, p.90). As Cisco had not made significant inroads into the telecommunications equipment manufacturer in 2001, it suffered less than the more telecommunication-focused rivals from the bursting of the telecom bubble and its revenues fell only from \$22.3 billion in 2001 to a low of \$18.9 billion in 2003 before rapidly picking up again. It did, however, find itself obliged to declare an exception \$2.5 billion write-off for excess inventory in 2001, as its contracts with subcontractors required it to pay for supplies it no longer needed in the downturn. In the same year, following the terrorist attacks on the Twin Towers in New York and as a sign of “tremendous confidence in the financial systems of our country, in our industry and in our market-leading position both today and into the future”¹³, Cisco initiated a stock repurchase program of up to \$3 billion for the coming two years. Initially it appeared that Cisco was adhering to the use of stock repurchases outlined in the 1999 report, and using its cash pile to shore up its stock price in a downturn. As both the market and company revenues picked up from 2004, however, Cisco continued to spend massively on stock buybacks. By July 2016, which represents the end of the fiscal year for Cisco, the company had spent a total of \$97.5 billion buying back its own shares, an annual spend of \$6.5 billion over a period of 15 years. In 2011, the company announced that it would start distributing dividends and the combination of these two forms of “value extraction” (Lazonick, 2014) has comfortably surpassed spending on R&D every year for the 15-year period, except the year of the financial crisis, 2008 (Figure 13).

Our detailed research on Cisco reveals that as it dramatically ramped up its spending on stock buybacks in the first half of the 2000s it eschewed making deep investments in carrier-class communications equipment, a segment that, as a result of acquisitions made in the previous boom, it was positioned to enter. Instead most of Cisco’s acquisitions during the 2000s brought the company products that turned out to be commodities. Given its dominant position in enterprise communication equipment, the growth of data centers and cloud computing enabled Cisco to increase its sales from \$22 billion to over \$49 billion from 2004 to 2016 and its employees from 34,000 to 74,000. But, with an obsessive focus on manipulating its stock price, Cisco ceased to be an innovative enterprise (Bell et al, 2014).

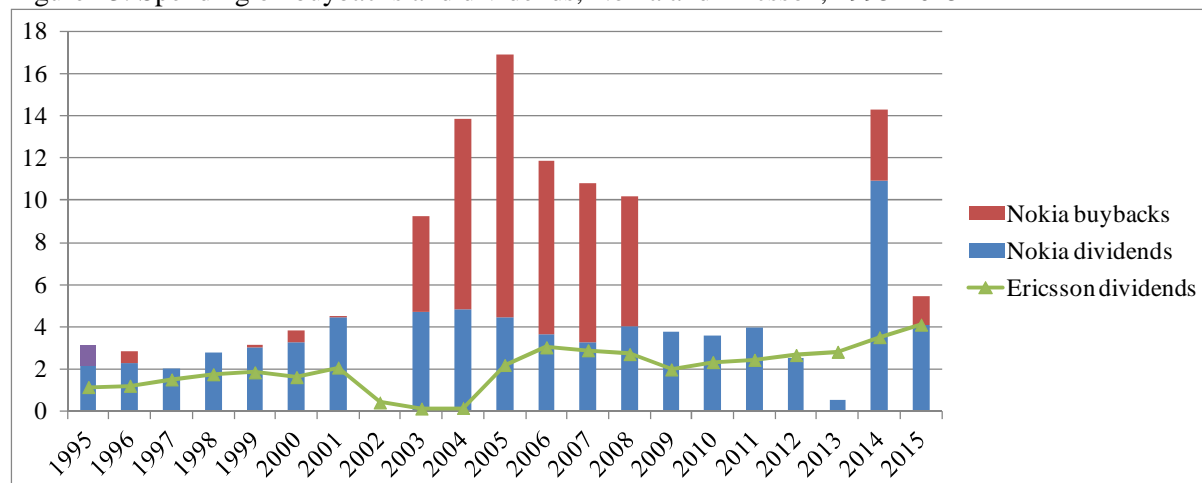
Today, as we have seen, the world leader in communication technology—the company that, in our view, Cisco could have been—with large market shares in service-provider equipment, networking equipment, and consumer handsets is the Chinese company Huawei, founded in 1987 in the then unsophisticated city of Shenzhen, three years after Silicon Valley’s Cisco emerged out Stanford University. Through a retain-and-reinvest allocation regime, by 2016 Huawei had \$78 billion in revenues and 180,000 employees. Of course, Huawei does not do stock buybacks because, as a 100% employee-owned company, it is not listed on a stock market.¹⁴

The two European firms that remain in the industry in 2016 have diverged significantly in relation to their distributions to shareholders over the period studied, as can be seen from a comparison the practices of Nokia and Ericsson during the twenty-year period between 1995 and 2015 (Figure 13).

¹³ “Cisco Systems Announces Stock Repurchase Program”, Cisco Press Release, September 11 2001.

¹⁴ Huawei Investment & Holding Co., Ltd., 2016 Annual Report

Figure 13: Spending on buybacks and dividends, Nokia and Ericsson, 1995-2015

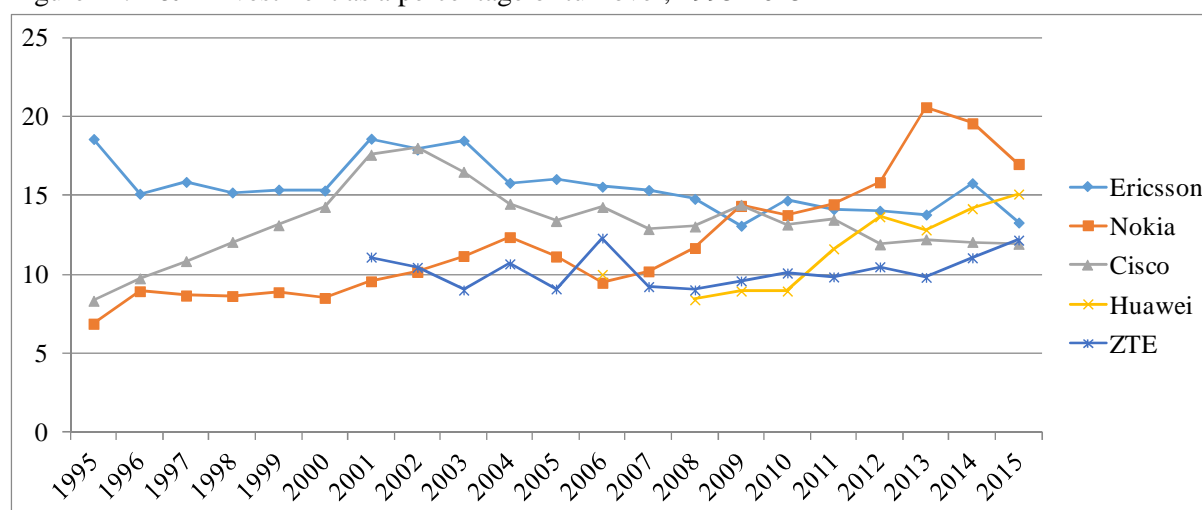


Source: Capital IQ

Compared with Cisco, the use of value extraction mechanisms is clearly consistent while Nokia's use of buybacks over the past decade is more sporadic. In explaining its plan to repurchase €1.25 billion of its shares, Nokia's 20-F filing for 2003 simply presents the measure as part of a capital structure optimization, along with a special dividend of €1 billion to accompany the €0.4 billion ordinary dividend. In November 2016, Nokia announced that its newly announced capital optimization program involved repurchasing €1 billion shares.¹⁵

Over time, all five firms that remain in the sector consistently maintained the percentage of their revenues spent on R&D in double figures (Figure 14), but Nokia's investment in R&D in the mid noughties declined as it increased buybacks. This is precisely at the time when Apple was developing the iPhone launched in 2007. The significant rise in the percentage in 2013 is related to the sale of its handset business to Microsoft, ironically due to its inability to develop a competing smartphone platform to those of Apple and Android. Given Huawei's significant turnover, it has now become the company in the sector that is investing by far the largest in R&D.

Figure 14: R&D investment as a percentage of turnover, 1995-2015



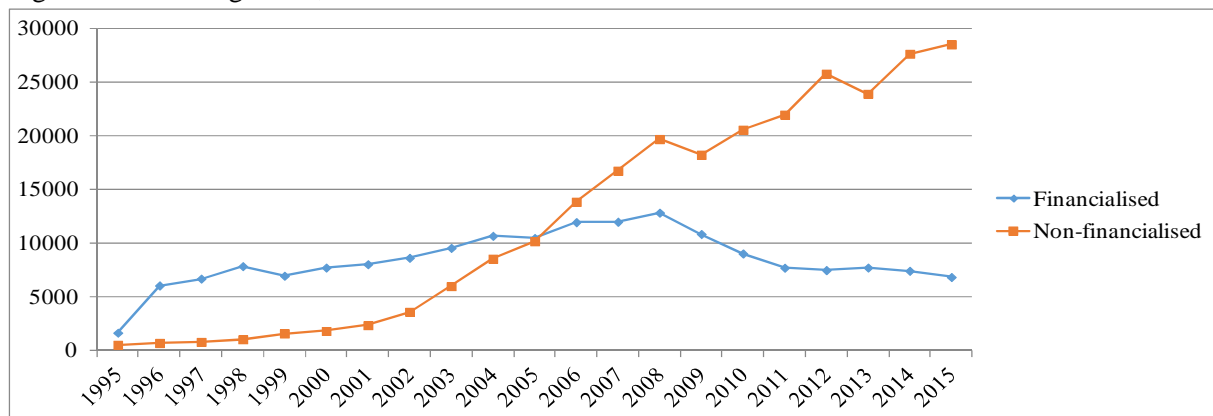
Source: Capital IQ

¹⁵ "Nokia Corporation to repurchase own shares in line with its capital structure optimization program", Nokia Press Release, November 15, 2016.

3.2 Organisational integration

It is not enough to invest in R&D, as this investment needs to be transformed by the company's employees and partners into innovative goods and services, through an on-going process of organizational learning. While patent data is far from a perfect measure of innovation, the number of patents granted to the two financialised firms (Nokia and Cisco) remaining in the industry has been largely surpassed by the three non-financialized firms (Huawei, ZTE, Ericsson) since 2005 (Figure 15). In 2015, Huawei was granted over 14,000 patents, ZTE almost 7,500 and Ericsson 6,647. The figures for Cisco and Nokia, respectively, were 2,175 and 3,690, although from 2016, Nokia can include the 2,882 patents granted to Alcatel-Lucent, bringing its total to over 6,500 for 2015.

Figure 15: Patents granted, 1995-2015



Source: PATSTAT**check with Erdem

A firm's ability to achieve organizational integration depends on how it puts in place a set of relations that creates incentives for its employees to apply their skills and efforts to collective learning processes. As is characteristic of New Economy firms, Cisco's stock price affects the compensation of most of its employees. Cisco grants stock option awards to virtually all of its employees but gains from exercising stock options have changed dramatically at Cisco over the past two decades. As can be seen in Table 3, during the Internet boom, when in March 2000, Cisco had the highest market capitalization in the world, the top highest paid executives at Cisco raked in tens of millions of dollars from gains in stock options.

The average gains of the top five are typically several hundred times larger than those of the average employee (Table 3). From 1992 through 2015, as an executive at Cisco, current CEO John Chambers received \$717 million, or an average of \$29.9 million per year. Of this amount, 89.1% percent came from the gains from exercising stock options, while another 4.6% (not shown in Table 3) came from the vesting of stock awards, a form of stock-based pay that Cisco, like many other US companies have increasingly used since the Great Financial Crisis. From 2009 through 2015 Chambers received \$33.0 million from the vesting of stock awards and \$67.5 million from the exercise of stock options.

Table 3. Cisco Systems, average gains from exercising stock options, top five executives and other employees, 1995-2014

	Average gains of top five, \$	Average gains of other employees, \$	Number of employees. end of fiscal year	Ratio of gains for top five to other employees
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
2013	1,685,579	6,120	75,049	275
2014	3,435,366	5,954	74,042	577
2015	4 240 540	5,747	71 833	738
2016	790 187	3,556	73 700	222

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

Table 3 also shows that the gains from exercising stock options across all employees at Cisco varied dramatically over the two decades, reaching an astonishing \$193,000 across 21,000 employees (not including the top five highest paid) in 1999 and \$291,000 across 34,000 employees in 2000. These types of gains fed into the hypermobility of labor in Silicon Valley, where Cisco is located, that has undermined collective and cumulative learning processes, and hence innovation (Lazonick et al, 2014). The gains from exercising stock have been much more moderate since 2002, although they spiked to \$73,000 across 61,500 employees in 2007, when the stock market was booming. Since the financial crisis, in addition to the gains from exercising stock options at Cisco, which have averaged between about \$4,000 and \$6,000 per employee, the company has also been granting stock awards, known as restricted stock units, to a broad base of employees. An important focus of our ongoing research is on the relation between stock-based pay and value-creating capabilities at Cisco and other companies that have been grappling with the problem of whether stock-based pay supports or undermines the organizational integration required to generate high-quality, low-cost products (Lazonick, 2017). Quite apart from the equitability of the distribution of stock options and stock awards across the company's tens of thousands of employees, the income derived from stock-based pay is often more the result of speculation and manipulation than innovation (Lazonick, 2016).

At Ericsson, our previous in-depth research on the purposes and impacts of broad-based stock options, made possible by extraordinary access to company data, shows how a European company that was not financialized experimented with US-style stock options for as many as 16,000 employees between 1998 and 2002, at which point the broad-based stock-option program was terminated. From 1998 to 2002 Ericsson, instituted a series of stock option plans, thus emulating a distinctly US mode of compensating high-tech personnel. Then in 2003, Ericsson did not renew its stock option program. Instead Corporate HR developed a unique employee stock purchase plan that made central use of an HR tool inherited from the 2001 and 2002 stock option plans to reward a subgroup of outstanding non-

executive employees. The Ericsson experience with stock options shows that corporate HR managers can graft an alien mode of compensation onto a well-developed organizational structure without undermining the integrity of that structure. Our close examination of the transfer of US-style stock options to Ericsson shows why convergence to the latest US business model is not an inevitable outcome, and how in global competition in the ICT industries alternative business models can still result in competitive success. (Glimstedt et al, 2006)

In contrast to Cisco, as an employee-owned company, Huawei does not give stock options. Huawei's founder, Ren Zhengfei, is quoted explaining the origins: "I designed the employee shareholding scheme soon after I founded Huawei. I had intended to knit all my colleagues together by a certain means of benefit sharing. At that time I had no idea about stock options; I did not know that this had been a familiar form of incentive for employees in the West, and there are a lot of variations. The frustrations of my life made me feel that I had to share both responsibilities and benefits with my colleagues. I discussed this with my father who had learned economics in the 1930s. He was very supportive. But no had expected that this shareholding scheme, which came into being by chance more than by design, would have played such a big role in making the company a success" (Tao and Chunbo, 2015, p.44-45). He goes on to explain why he believes that Huawei should not go public as this would mean some of its employees would become too rich too young and would become lazy. While details of the employee ownership scheme are not public, 65,596 of the company's 146,000 employees in 2011 were reported to have a stake in the company (Tao and Chunbo, 2015).

Apart from significantly different levels of incentives from stock option awards, the innovation efforts of employees at Cisco are also differentiated by a practice introduced in 2004 and termed "spin-ins" whereby a small number of executives who had previously worked for the company benefited from significant one-off gains. A key element of the "spin in" concept was Mario Mazzola, who had joined Cisco with its first hugely successful acquisition of Crescendo and who went on to become the firm's Chief Development Officer. In 2004, he was in this role when the first spin-in, Andiamo, was carried out (Spandler, 2012) and he subsequently left the firm to participate with colleagues in a data center start-up, Nuova which was "spun in" in 2008. Once three of the engineers from this company received their final mile-stone payment in 2011, they left Cisco with \$100 million in seed funding to start a new SDN project, Insieme, which Cisco subsequently acquired for \$750 million in 2012 (Burrows, 2012). The departure of a key executive in 2008, Jayshee Ullal, has been linked to the practice of spin-ins. As she was vice-president of Cisco's Data Center technology group and was also a Crescendo veteran, it was suggested that she was unhappy not to have shared in the two payouts made to Crescendo-Cisco veterans (Matsumo, 2008). She, herself, however explained that the internal effects of such payouts make managing a research team difficult: "Spin-ins are a creative model to accelerate innovation and bring in engineers you couldn't normally recruit--and financial gains go to entrepreneurs, not venture capitalists," says Jayshree Ullal, a 15-year Cisco veteran who built the [Nexus] 7000 then left last May as the Nuova people came back in. "But it's a nightmare when the guy in the next cubicle is a multimillionaire and you aren't, because you weren't chosen." She left Cisco for personal reasons, she says, adding that she had to deal with a lot of unhappy employees over the spin-in structure" (Matsumo, 2008). Shortly after his appointment as CEO, it was reported that Chuck Robbins was not going to continue the practice of spin-ins and was replacing it with internal development teams and justified it as an "internal start-up model... [with] similar environments for [employees], similar benefits for them upon success" (Bort, 2015). Mario Mazzola and his three main spin-in colleagues left Cisco in June 2016 (Hesseldahl, 2016).

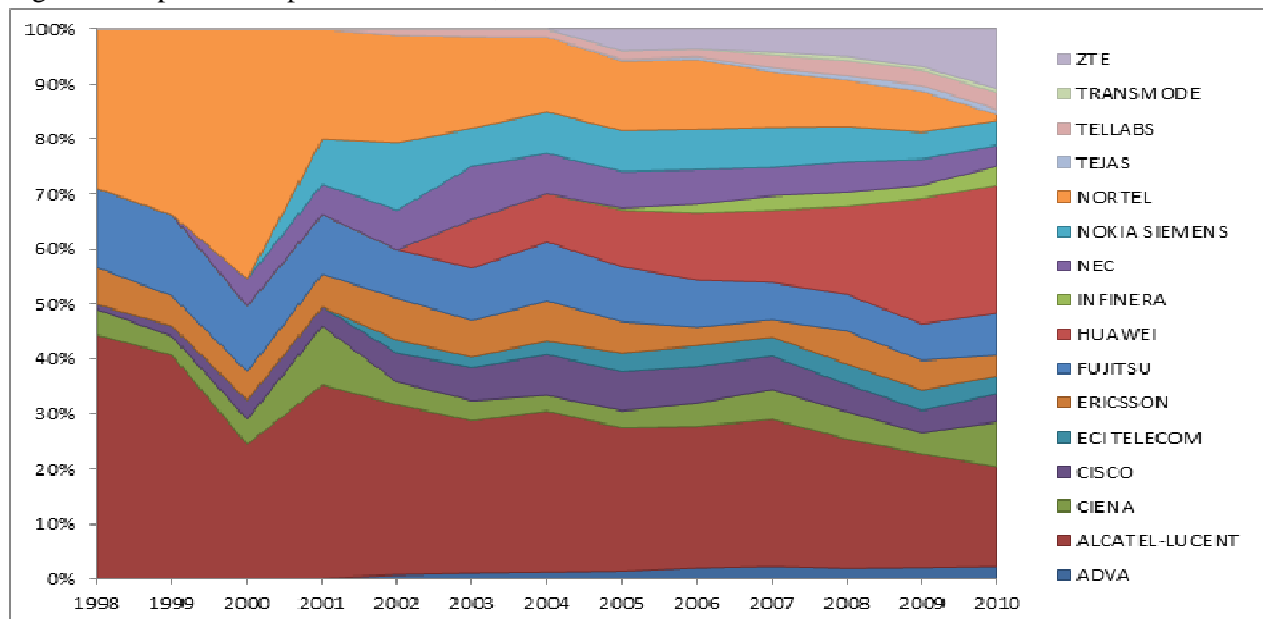
3.3 Strategic control

Transforming strategy into innovation requires strategic control, a set of relations that allow decision-makers allocate the firm's resources to achieve the means necessary to confront the technological, market and competitive uncertainties inherent in the innovation process. Financialization can undermine this process as managers either as managers are not sufficiently aware of the innovative capabilities that are needed and how to build them or because they are not incentivized in a way that encourages them to attain and sustain investments in the necessary capabilities.

On-going positive financial performance in the short term may blind firms to the reality of what is really happening in the marketplace. In Nokia, for example, during the period when the smartphone was being developed, it has been suggested that the company's on-going success in short-term financial measures was found to have misled managers about the serious competitive threat from Apple's iPhone. Vuori and Huy (2016) report that: "[middle managers] remained aware of macro measures of their company's performance, but these measures – which again reflected the past rather than the present – also suggested there was 'nothing to worry about'. As quarterly evaluations by the stock market were important for Nokia, positive market news strongly influenced [middle managers'] appraisals of external competition and calmed their external fears" (p.28).

For Cisco, the move into optical networks in the late 1990s indicated that the firm was aware of the potential of this sector to enable the company to develop carrier-class equipment and expand its business. It made eleven significant share-based acquisitions, valued at over \$16 billion and was willing to move into manufacturing in order to develop the necessary systems integration capabilities to compete. With the downturn in 2001, however, Cisco appears to have begun to question the wisdom of moving into carrier-class equipment and it closed the plant and laid off its 500 workers (Bell et al, 2012). In 2004, Cisco again identified optical networking as a one of six advanced-technology areas with the potential to become \$1 billion businesses. The company does not appear to have sustained significant investment in the area, however (Duffy, 2009), in light of strong competition from another firm who won the leading position in the segment that had been targeted by Cisco, Huawei (Figure 16).

Figure 16: Optical transport market share, 1998-2010



Source: Dell'Oro

In the optical networking area, another small, but growing, competitor is Infinera, a firm that is led by a former employee of Cisco. Tom Fallon had been an operation manager at Cisco from 1993 until 2001 when he was made General Manager of Cisco's Optical Transport Business. In 2003, he became Cisco's Vice President of Engineering and Operations but left to take up a position at Infinera in 2004 as Chief Operating Officer and Vice-President of Engineering and Operations. He became President and CEO of Infinera in 2010. The company makes Photonic Integrated Circuits, or PICs, that combines dozens of optical components onto two tiny chips and are manufactured in its plants in California and Pennsylvania. From its foundation, Infinera has emphasized the importance of cross-functional interaction and manufacturing insights in the area of optical network design: "We began the design and manufacture of our PICs shortly after we were founded in December 2000. We employ a multi-disciplinary approach towards the development and manufacture of our PICs, with significant interaction between our manufacturing, system engineering and advanced technology groups".¹⁶ If this vision of vertical integration of manufacturing and design is typical proves to be what is needed to generate superior products for this market, Infinera's management will have shown the necessary level of strategic integration to innovate by transforming the technological, market and competitive conditions that other, more financialized companies, might take as "given constraints".

The challenges of achieving such strategic integration are far more complex, however, in a multi-segment, full-service equipment vendor that is competing in both fixed and wireless markets across the globe. Such vendors face the added complexity of the IoT and the lack of visibility of what platforms will emerge to service the array of applications that are promised.

4. Conclusion

The Spectrum Report that was cited in the introduction was published as the Internet and telecom booms were still in full swing. In 1999, it noted that cash was piling up in the sector with a combined \$20 billion on the balance sheets of the top ten vendors. It concludes that this is illogical: "Certainly cash mountains provide a cushion for bad times should they occur, but no sign of a downturn can be seen on the horizon. The interest on the cash and gains on the investments do 'top up' earnings, but earnings are robust already. Cash could be used to buy back stock to support the share price in a soft market, but little need for that is apparent. To make more investments in equipment is unnecessary. Investing in promising young companies with interesting technology is a popular and worthwhile endeavor: one day the start-up can be acquired or the shares sold for a huge gain. But this type of activity can make the OEMs into investment bankers and venture capitalists. So, what is the purpose of keeping so much cash? No one is saying: the subject is not mentioned in the annual reports of any of the telecom OEMs" (Spectrum Telecommunications Report, 1999, p.90).

Since then, to various degrees, firms in the industry have been distributing cash to shareholders via dividends and share repurchases and the overall amount distributed has risen from approximately \$2 billion in the middle of the 1990s when revenues were at \$130 billion to a high point over \$30.3 billion in 2015 when revenues totaled \$231.5 billion. The technological and market dynamics of the sector have continually evolved with new generations of mobile standards and different rates of growth. The bursting of the Internet bubble the start of the century and varying levels of competition among operators in different parts of the world have influenced existing players to different degrees. It is, therefore, not straightforward to link performance to different levels of financialization.

In this analysis, however, we argue that firms that extracted value have shown less capacity to develop innovative capabilities than those who did not. This contrast is particularly striking between

¹⁶ Infinera Corporation 2011 Annual Report on Form 10-K, p.6.

Cisco, a company that had accumulated both significant capabilities and a large pile of cash, at the time of the bursting of the Internet bubble, and Huawei, a new entrant that reinvests its profits and does not have external shareholders. Juniper, the other significant US firm in the sector, is increasingly under pressure from activist shareholders to distribute a greater share of profits. Other firms in the sector have been less prone to distribute cash, but Nokia, one of the final two European firms remaining in the sector, has shown a willingness to do so—and it is clear that stock buybacks played a role in Nokia's failure to compete in the smartphone market.

The opportunities for future growth built around the IoT will require significant investment in new capabilities while uncertainty remains high regarding both the technological platforms that will support the new applications and the business models that will generate income from final users of such applications. Massive distributions of cash to shareholders during such a period will not contribute to the social conditions of innovative enterprise that must be maintained within a firm if it wishes to be in a position to take advantage of such opportunities in the long-term.

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Appendix 1: Revenues of leading communications equipment suppliers, 1996-2016

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
American firms																					
Lucent	17 734	19 765	21 413	21 145	26 360	30 147	38 303	33 813	21 294	12 321	8 470	9 045	9 441	8 796							
Motorola	18 770	20 653	20 513	30 931	37 580	30 004	26 679	27 058	31 323	36 843	42 879	36 622	30 146	22 044	19 282	8 203					
Nortel Networks	12 917	15 449	17 575	22 217	30 293	17 428	10 542	10 193	9 828	10 523	11 418	10 948	10 421	4 088	620	27	7				
Cisco	4 096	6 440	8 459	12 154	18 928	22 293	18 915	18 878	22 045	24 801	28 484	34 922	39 540	36 117	40 040	43 218	46 061	48 607	47 142	48 675	49 247
3Com	3 147	5 420	5 772	4 334	2 821	1 478	933	699	651	795	1 267	1 295	1 317	1 254							
Qualcomm	3 348	3 937	3 197	2 680	3 040	3 971	4 880	5 673	7 526	8 871	11 142	10 416	10 991	14 957	19 121	24 866	26 487	27 491	27 491	25 281	23 554
Juniper		0	4	103	674	887	547	701	1 336	2 064	2 304	2 836	3 572	3 316	4 093	4 449	4 365	4 669	4 627	4 858	4 990
	60 012	71 665	76 932	93 563	119 695	106 208	100 798	97 015	94 003	96 218	105 964	106 084	105 428	90 572	83 156	80 763	76 920	80 767	79 260	78 814	77 791
European firms																					
Ericsson	18 531	21 960	23 197	26 040	29 827	22 413	15 004	14 580	17 963	20 301	24 111	27 788	31 682	26 996	28 223	34 949	33 623	34 900	33 207	29 250	25 344
Alcatel	16 464	17 110	17 766	14 598	24 884	24 269	17 354	15 771	16 606	15 559	16 206	25 982	23 732	21 723	21 450	19 912	19 047	19 880	15 951	15 504	
Siemens ICT	13 072	15 477	17 178	24 894	23 445	21 463	18 984	18 470	21 936	16 683											
Nokia	7 766	10 391	15 648	21 040	27 974	27 903	28 304	33 289	36 359	42 470	51 615	69 889	74 200	56 986	56 168	53 764	38 761	16 873	16 888	16 729	26 044
Marconi	1 309	1 479	1 508	5 103	6 712	4 648	3 062	2 674													
	57 141	66 416	75 296	91 675	112 843	100 696	82 709	84 784	92 864	95 013	91 933	123 659	129 614	105 705	105 840	108 625	91 431	71 653	66 047	61 483	51 388
Asian firms																					
NEC	15 505	14 193	11 399	14 833	14 558	14 749	13 351	17 045	17 646	15 204	23 480	28 744	27 530	8 878	7 677	8 010	7 157	7 261	6 337	6 395	6 296
Fujitsu	6 911	6 535	5 517	7 147	6 198	4 747	6 716	6 172	2 835	3 235	3 015	3 563	3 743	3 488	3 296	3 254	2 981	2 838	2 859	2 834	2 223
Huawei										5 982	8 504	12 560	18 329	21 831	28 085	32 349	35 326	39 482	46 468	60 841	75 103
ZTE	37	76	238	307	546	1 141	1 304	2 058	2 564	2 674	2 948	4 761	6 491	8 827	10 657	13 682	13 511	12 427	13 136	15 431	13 161
	22 453	20 804	17 154	22 287	21 303	20 636	21 371	25 275	23 045	27 095	37 947	49 628	56 093	43 023	49 715	57 296	58 975	62 008	68 800	85 501	96 784
Total	139 606	158 884	169 383	207 525	253 840	227 539	204 878	207 074	209 912	218 326	235 844	279 371	291 136	239 300	238 712	246 683	227 327	214 429	214 107	225 797	225 963

Sources:

Capital IQ: Nortel Networks, Cisco, 3Com, Qualcomm, Juniper, Ericsson, Siemens, Nokia, Huawei, ZTE

Factset: Lucent, Nortel, Alcatel, Marconi (200-2003)

Annual Reports: NEC, Fujitsu (for networking, telecommunications divisions, where reported)

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