The Telecommunication Industry: Cisco and Lucent's Supply Chains

by

Yishai Boasson

M.Eng.
Massachusetts Institute of Technology

The Telecommunications Industry: Cisco and Lucent's Supply Chains

by

Yishai Boasson

Abstract

This work aims at describing the current trends in supply chain management prevalent in the telecommunications industry. This is done through looking at the telecommunications industry (telephony and data communications), its history and the factors shaping what it currently is. In addition, two companies – Cisco Systems Inc. and Lucent Technologies Inc. are used as two case studies. Looking at these two companies enables us to dive deeper into actual supply chain practices, trying to understand current best practices.

As we analyzed these two companies' supply chains, we used a framework delineated by the belief that excellent supply chain management is a collection of business processes supporting operational goals, which in turn should enable an overall business strategy.

Our initial perception of current supply chain practices was shaped by available literature as well as by the image projected by telecommunications companies in forums and publications concerning their supply chain management practices. However, the opportunity to look closely and intimately at one of Cisco's supply chains has revealed a slightly different picture, where supply chains are not necessarily used as a means to gain sustained competitive advantage. In addition, marked differences in the two companies'

practices might be attributed not only to differing strategies, but also do differing histories.

Acknowledgements

The author would like to thank Prof. Yossi Sheffi, Prof. Charles Fine and Dr. Larry Lapide for their invaluable guidance, as well the great people of Cisco Systems Inc., for contributing of their valuable time and insights. Thank you Randy Pond, Jim Miller, Matt McCombs, Rachel Peterson, Frank Kull, Gene Brock, John McCool and Stacey Olson; for your generous help and candid cooperation.

Table of Contents

List of Tables

List of Figures

1 Introduction

The following work takes a look at the telecommunications and data-communications equipment manufacturing industry as embodied by two companies: Cisco Systems, Inc. and Lucent Technologies Inc. The motivation for doing so is the Supply Chain 2020 Project, undertaken by the Center for Transportation and Logistics at the MIT Engineering Systems Division.

> The Supply Chain 2020 (SC2020) Project is a multiyear research effort to identify and analyze the factors that are critical to the success of future supply chains. This pioneering project will map out innovations that underpin successful supply chains as far into the future as the year 2020. The first phase of research focuses on understanding excellent supply chains. It involves identifying and researching the organizations that drive today's successful supply chains in a broad range of industries, with the aim of understanding the evolving business strategies, operating models, practices and principles that are responsible for driving improved performance.[1]

There are a few reasons for choosing to look at Cisco and Lucent, and through that trying to understand a segment of the telecom business. For one, this industry is not only large, complex and generating huge amounts of revenue as well as influencing the lives of us all, but it is also very likely to become even more important as we move towards the future. As the Supply Chain 2020 project is future oriented, there is great appeal in looking at an industry that is not only likely to still be present in the future, but is actually shaping what this future might look like.

In addition, the history of these two companies bears the scar of a traumatic event, the collapse of the telecom bubble in 2000-2001. This provides researchers with a unique

opportunity to try and understand what parts of these companies' strategies and supply chains were considered important before the crash, when emphasis was put on growth and what other parts of their strategies are considered important now. These insights may be gained through looking at the changes and restructuring these companies undertook following the crisis, as well as by trying to understand the parts of their pre-crisis strategies that might have exacerbated the dynamics which had led to the events of 2001.

As far as defining excellent supply chains goes, this work does not claim any one company holds an outstandingly excellent supply chain strategy that should be endorsed as such. When setting out to look at these two companies, it was not this paper's intention to glorify one supply chain as excellent or berate another as inadequate. However, it seems that the mere fact these two companies managed to survive the 2001 crisis serves as evidence for the adequacy of their then-existing structures, while their current restructuring efforts, built on past learning while driven by forward looking agenda will hopefully provide them the desired resiliency to future uncertainties, while enabling growth.

[1] http://web.mit.edu/ctl/www/research/sc2020/re_sc2020.htm

2 Literature Review

Literature surveyed for this paper consisted of several different types of sources, including journal and news articles, books about specific companies and the telecom industry as a whole, analysts' reports, U.S. Securities and Exchange Commission (SEC) filings and data released by companies available on company websites as well as in presentations given by company executives. When analyzing this data, two main strata were used as a framework for analysis; industry level view and company level view.

This chapter aims at synthesizing the different views about the industry and the studied companies, as well as at describing the specific characteristics of each type of data source.

2.1 Industry level views

Looking at the industry level, analysts' reports hold the most information. This information includes not only an overall description of what the industry is about (what are the services provided and products manufactured), but also insights into trends, along with predictions for the future. However, these reports also indicate a fuzzy borderline between the computer networking industry and the telecommunications industry, with signs of integration between these two industries[2,3]. This blurred distinction between the

[2] Gartner Group, Predicts 2005: Communications Services Are Changing, November 1st 2004, https://web.mit.edu/is/gartner/intraweb/research/123800/123887/123887.html, accessed 1/22/2005

two industries is a consequence not only of the fact that equipment manufacturers such as Cisco and Lucent manufacture products which are consumed by both Internet service providers and networks, as well as telephony service providers, but also the fact the telephony services are shifting from circuit switching technology to packet switching technology[4]. In addition, both kinds of service providers are providing more and more services that were traditionally within the scope of the other industries provided services. Example of these trends include telephony service providers selling end users telephone lines dedicated for computer connections, as well as other services like Internet access and mobile service, telephony services provided over the Internet[5], either for free or for a fee (Voice over IP (VoIP)[6], like Skype and Vonage)[7], as well as new players like cable TV providers adding telephony and computer connectivity to their array of offered services. In addition, a move to "converged" networks is mentioned in many of the analysts' reports[8]. These networks will provide "triple-play"[9] – voice, data and video, through one single pipeline, be it direct fiber optic connection to the user (Fiber To The User – FTTU), cable, or dedicated network[10]. These networks will not only drive bandwidth demand up, but will also drive more advanced carrier media (fiber optics etc.)

---

[3] U.S. Interactive, Industry Solutions: White Papers: e-Business Transformation: Challenges for the Communications Industry http://www.usinteractive.com/news/analysis/ebusiness_transformation.asp, accessed 10/5/2004

[4] Deutsche Bank Industry Update, sponsored Investor Conference Call, A switch to packet: The transition from circuit, October 2nd 2003, A conference call with industry consultants Kermit Ross and John Celentano summary, by George C. Notter and Cobb Sadler

[5] Gartner Research Brief: IP Telephony Adoption Poised to Dominate North American Market, August 24th 2004

[6] Morgan Stanley Industry Overview, Voice-over-IP Conference Highlights, in Wireline Networking Equipment, May 20th 2004

[7] Associated Press, The new telephony: VoIP turning telecommunications business inside out http://www.cnn.com/2005/TECH/Internet/04/13/new.telephony.ap/index.html, accessed April 13th 2005

[8] Standard & Poor's, Computers: Networking Industry Survey, September 18th, 2003

[9] Gartner, Telecom and TV convergence Becomes a Triple-Play Reality, October 4th 2004 https://web.mit.edu/is/gartner/intraweb/research/123600/123608/123608.html, accessed 1/22/2005

[10] Morgan Stanley, Morgan Stanley Global Communicator – June 04, June 29th 2004

closer to the end consumer and deeper into the networks. Nevertheless, it is not only new service providers that endeavor to enter with this new technology, but established incumbents as well, such as wire-line service providers who are seen upgrading their infrastructure in preparation. Although this means growth in both switch and router sales due to replacements[11], there seem to be signs that router and switch sales do not follow identical trends. Nevertheless, as services provided shift from one medium to another, this might require clients to upgrade their networks as well[12]. This would include the broadening of the clients' networks, as new services provided would enable new business practices, such as teleworking, i.e. working from the home, enabled by data connections[13].

The trend towards "everybody provides everything" can be seen in the past consolidation of traditional data networking vendors and telecom equipment suppliers, as noted by S&P[14]. Examples of such consolidation are the $9.1 billion acquisitions of Bay Networks by Northern Telecom (later changed its name to Nortel Networks) in 1998, as well as the acquisition of Ascend Communications by Lucent in 1999 for $16 billion. In both cases, the deals combined leaders from the networking industry with leaders in the telecom equipment sector. It is widely agreed that Cisco not only managed to capitalize on market shifts due to its aggressive acquisition practices throughout the years, but it had turned itself into an overall market leader building on these practices, as well as on effective marketing and excellent execution, forcing other competitors to scramble to

[11] Gartner Dataquest Market Analysis, Ethernet Switch Market Shows Signs of Strong Recovery in 1Q04, August 4th 2004
[12] Gartner Group, Predicts 2005: Communications Services Are Changing, November 1st 2004, https://web.mit.edu/is/gartner/intraweb/research/123800/123887/123887.html, accessed 1/22/2005
[13] Gartner, Teleworking: The Quiet Revolution, September 17th, 2004 https://web.mit.edu/is/gartner/intraweb/research/122200/122284/122284.html, accessed 1/22/2005

meet the standard it is setting[15]. The shifts in the marketplace that have enabled this growth are the increasing demand for an end-to-end solution provider (which is consistent with Cisco's strategic view, as will be elaborated on in the following chapters) as well as the very rapid introduction and adoption of new technologies, which does not favor Research and Development (R&D) efforts by larger companies. Other key points made by that specific Standard & Poor's report (but are also reiterated by other analysts) are the importance of heavy R&D investment (typically more than 10% of sales) as well as an ability to quickly shift gears as soon as a trend is recognized, or as soon as signals are received from the market. Examples given are Cisco's shift to switching, which gave it a boost over its rival Bay Networks, as well as Lucent's failure to move to high speed fiber optic equipment, which gave its rival Nortel a major advantage in 2000.

As the ability to quickly switch direction following demand signals depends heavily on the ability to correctly forecast demand and adjust manufacturing abilities accordingly, reports mention an industry-wide move to outsourcing as a way to achieve the desired flexibility through contract manufacturers. This should be coupled by stronger contacts with customers that would allow better information collection and forecasting. Again, Cisco is mentioned as a prime example of setting up an online communication channel with clients.

Similar price pressure sometimes cause even service providers, like the Indian Bharti Televentures carrier to outsource parts of their operations[16], including billing, data

---

[14] Standard & Poor's, Computers: Networking Industry Survey, March 13th, 2003
[15] Ibid.
[16] Gartner, Telecommunication Network Outsourcing Has Promise and Risk, September 7th 2004 https://web.mit.edu/is/gartner/intraweb/research/122300/122380/122380.html, accesses 1/22/2005

centers, disaster recovery, helpdesks, Customer Relationship Management (CRM) and data-warehousing, cellular network maintenance, Quality Assurance (QA) etc. to outside parties. Interestingly, these outside parties are sometimes the equipment manufacturers (such as Ericsson and IBM).

Equipment manufacturers' customer segment analysis in these reports[17] follows closely with Cisco's way of segmenting the market into three segments: 1) Enterprise, including large corporations, government and education, 2) service providers, both datacom and telecom, cable companies and wireless service providers, and finally 3)small and midsize business, home office and residential users. Different sales methods are used to serve different segments, with many vendors using a two-tiered approach[18], with direct sales for the large corporate clients and distributors and resellers to service smaller corporate, small and international customers. However, as the use of indirect sales force distances vendors from their customers and lowers margins, the Internet is mentioned as a sales tool gaining momentum, with Cisco (again) leading the way, reporting booking about 90% of its 2003 orders over the Internet.

[17] Standard & Poor's Computers: Networking Industry Survey, September 18th, 2003
[18] Standard & Poor's Computers: Networking Industry Survey, March 13th, 2003

2.2 Company level views

In trying to understand the way Cisco and Lucent operate their supply chains and the way they view their supply chains strategically, several sources were of great value. These sources included news and journal articles about the companies, books about the companies, books about supply chain management in which these companies were analyzed or given as an example, as well as theses. An advantage of using theses is that sources are religiously cited. Theses also provide insight into the workings of an industry, as well as sometimes proprietary information gained through interviews with company personnel. Although company names are oftentimes masked in theses, this obstacle can be overcome if the information is needed for academic purposes and anonymity is guaranteed.

2.2.1 Cisco

Books reviewed can be roughly divided into two categories: books about Cisco and books about supply chain management that mention Cisco's operations. Generally speaking, reference material can also be classified according to the time it was written, either before the 2001 crash or after it. Although material written before the crash can be valuable in respect to the factual descriptions provided therein, it is much lacking the benefit of hindsight in its analysis of the way Cisco's supply chain relationships actually performed in time of trouble. Hence, since it is very hard to paint a complete and true picture of any subject, it is understandable that oftentimes the analyses presented in these books choose to concentrate on aspects of Cisco's activities which may have contributed to its growth and industry dominance, but are less important to understanding Cisco's

survival. However, it is important to stress that these sources really did provide very high quality information, and it would of course be wrong to subject them to hindsight, always being 20/20.

Such two books are the ones by Bunnell[19] and Paulson[20]. In his book, David Bunnell, besides providing the reader with the history of Cisco, draws a very vibrant picture of the people and events which shaped Cisco's way of doing things. Bunnell points to several key issues that are worth mentioning. The first of those is the persistence of some corporate traits throughout Cisco's different life phases, such as the importance given to listening to the customer, the extensive use of the Internet, the structured M&A process and the importance of alliance formation. As far as specific supply chain mechanisms go, Bunnell describes the virtual manufacturing and direct delivery concepts and the way they were executed circa 1996-7, along with the appointment of UPS-WL to be Cisco's 3PL service provider to the European market in 1997, serving the product supply chain. In addition, Bunnell describes the move by Chambers to consolidate the various autonomous business units into the three lines of business still guiding Cisco today: Enterprise, Small and medium business and Service provider. Bunnell finishes off with a review of current (for the time) rivalry faced by Cisco, as well as by marking possible future trends like the move to converged networks supported by optical infrastructure.

[19] David Bunnell and Adam Brate, Making the Cisco Connection: The Story Behind the Real Internet Superpower (New York: John Wiley & Sons, 2000).
[20] Ed Paulson, Inside Cisco: The Real Story of Sustained M & a Growth (New York: Wiley, 2001).

On the other side of the binoculars is Ed Paulson's book[21]. This book, more than anything else, is a guide written for companies looking to be acquired by Cisco, a prospect which at the time (and perhaps still now) was considered to be a very lucrative exit strategy. Although the book describes Cisco's M&A mechanisms and procedures in great detail, the sections most interesting as far as supply chain practices go is the section on integrating products and production. However, as a senior Cisco executive noted in an interview, Cisco no longer buys companies for their physical products, but rather for features or technology it can integrate into its own line of products. In addition, the manufacturing processes allocation between outsourcing and in-house might no longer be true, as Cisco has since restructured that part of its operations.

One of the books enjoying the benefits of hindsight is the book by John K. Waters[22], published in 2002. It is very interesting to note how many of the themes delineated by the previously mentioned books are repeated in this book, withstanding the test of time (brief yet significant period of change). Although this book revolved around John Chambers the man, it also tells the story of Cisco, albeit on a strategic and narrative level rather than focusing on the supply chain management side which is of interest to this work. Among the themes revisited in this book is the focus on the customer as a corporate strategy guideline, the significance of M&A and the belief in the importance, power and future of the Internet. In addition, John Chambers' political ties are also analyzed, as well as some figures relating to his presidential campaign fundraising and lobbying. Although the book includes a description of the bubble bursting and the

[21] Ibid.
[22] John K. Waters, John Chambers and the Cisco Way: Navigating through Volatility (New York: Wiley, 2002).

reorganization efforts that followed, it does not present a deep analysis of the affairs that led to Cisco's position nor of the effects of its reorganization efforts; neither does it supply a full description of these efforts.

On the borderline between books about Cisco and books about strategy lies Platform Leadership[23]. This book uses Cisco as a case study (along with Microsoft and Intel) demonstrating the strategies used and actions taken by companies seeking to provide the technological foundation on which other companies, products, services and systems are built. Based on the insights and frame of reference given in the book, a part of Cisco's strategy will be analyzed later in this paper.

Other sources include newspaper, magazine and journal articles, as well as presentations, white papers, analysts' reports and more. Some sources cite Cisco's "Virtual Close[24]" and the information-systems enabled forecasting practices as part of the reason for the massive buildup of inventory. Among reasons given are the software's inability to tell the difference between real demand and overblown demand forecasts, generated by sales reps to hedge against shortages, along with an overall unjustified optimism by executives who have never seen a down quarter at Cisco[25]. This article for example cites Ajay Shah, CEO of Solectron Technology Solutions, a contract manufacturer for Cisco, saying that as soon as people saw a shortage, orders rose even higher. In concurrence with Shah, other sources agree that while Cisco's suppliers had

[23] Annabelle Gawer and Michael A. Cusumano, Platform Leadership: How Intel, Microsoft, and Cisco Drive Industry Innovation (Boston, Mass.: Harvard Business School Press, 2002).
[24] Cisco's Virtual Close is Cisco's ability to close its book on a moment's notice (all books are closed and reports are generated within an hour to four hours). This ability is enabled by a constant real-time flow of financial data.
[25] Scott Berinato, What Went Wrong at Cisco - Case Study: Cisco, August 1, 2001 2001, Case Study, CXO Media Inc., Available: http://www.cio.com/archive/080101/cisco.html, 10/31 2004.

differing views about the possibility of a forthcoming general economic downturn, Cisco's outsourcing model did not allow much in the way of voicing these concerns, due to lack of investment in Cisco's success on the part of the suppliers. This caused the suppliers and contract manufacturers not to be incentivized to voice dissent from Cisco's views. However, there seems to have been some suppliers who actually did incorporate into their forecasting mechanisms some consideration of macro factors and future trends. Such is the case with Xilinx, who looked at macroeconomic factors like debt level and economic spending into a forecasting mechanism based on that of Cisco's[26]. This world view (although challenged by Cisco, who claim the world economy is too complex to draw conclusions from) supports the SC2020 inclination to consider macro factors in constructing supply chains.

In regards to future growth, there is much coverage for Cisco's new products, ranging from the behemoth CRS-1, a router that can transfer the entire Library of Congress contents in under 5 seconds (reverently referred to by Cisco employees as HFR, standing for Huge Expletive Router), to home phones and mini routers. These reports are augmented by demand for bandwidth growth projections in the double and triple digit per year range, that although echoing optimistic bubble-years forecasts seem to be supported by anecdotal evidence, like the Japanese NTT DoCoMo figure of a 500% yearly growth in the demand for bandwidth[27]. These reports support the emerging picture of Cisco making products to support this growth, while making the products to generate the growth (such is the case for example with wireless Internet connection, the spread of

[26] Kris Chellam, Xilinx CFO quoted in Scott Berinato, What Went Wrong at Cisco - Case Study: Cisco, August 1, 2001, Case Study, CXO Media Inc., Available: http://www.cio.com/archive/080101/cisco.html, 10/31 2004

which was accurately forecasted by the former head of Cisco's commercial line of business, Charles Giancarlo in 2001)[28]. However, these reports also point out to some possible misalignments in Cisco's strategy, like the fact that while Cisco is pitching a sale to telephone service providers to buy its new products, they are simultaneously claiming phone services are becoming obsolete and will be replaced by free Internet phone services. This of course is not something telephone companies like to hear or care to support. In addition, Cisco products have yet to meet the high telephone switching equipment standards (99.999% uptime) that are very different than those employed in data networks. To top it all, while Cisco seems to be trying to compete on specific products (like the HFR) that are not necessarily part of a complete service package, they become more vulnerable to competition from more nimble technology-edge companies, with Juniper Networks being mentioned as such a threat, specifically on the huge router scene[29].

[27] Fred Vogelstein, "The Cisco Kid Rides Again," Fortune July 26, 2004 2004.
[28] John Pallatto, "Charles Giancarlo, in Charge of 4 New Technology Groups at Cisco Systems, Discusses Goals of the Firm's Latest Reorganization," Internet World 7.18 (2001).
[29] Vogelstein, "The Cisco Kid Rides Again."

2.2.2 Lucent

Data about Lucent was collected from internal, publicly available Lucent documents and filings, journal, magazine and newspaper articles, books and case studies/theses. Of these, Duncan Scholtz's work deserves special mention, as it has been a source of much of the information used about Lucent, as well as of some very important insights[30]. In addition, much of the material referenced by Mr. Scholtz (not including interviews) has been surveyed for this work as well. In his work, Mr. Scholtz describes the history and dynamics of the telecommunications industry, from its inception to the present day. He then proceeds to describe Lucent's history, its supply chain management practices before 2001, and the new Supply Chain Networks organization established post 2001. After providing a factual description of Lucent's supply chain practices, a short analysis of its success factors is given. Although this analysis is based primarily on the opinions of people within the organization, it seems to be surprisingly aligned with what Cisco executives are also claiming to be the strong point of their current strategy, namely simplicity, sensing and retrieving information, and the creation of a strong leadership team to leverage this information through the following of a path of greatest efficiency.

Other sources of information about Lucent's operations are two Stanford University case studies.[31,32] Although these two case studies do not yet reflect Lucent's new Supply Chain Networks organization, as they were written in 2000-2001, they do present Lucent's 1996 restructuring and the changing business environment it faced by

[30] Duncan M. L. Scholtz, "Lucent Scn: Leveraging the Fully Integrated Supply Chain," Master of Engineering in Logistics Thesis, Massachusetts Institute of Technology, 2004.
[31] David Hoyt, "Lucent Technologies: Global Supply Chain Management - a Case Study," ed. Hau Lee (Stanford, CA: Stanford University Graduate School of Business, 2001), vol.

2001. Particularly, case GS-01 discusses Lucent facing an increased demand in the Asian market in 2000, following massive outsourcing to Asia that enabled better customer satisfaction, cost cutting and increased market share, but perhaps exposed the company to component shortages. Naturally, being case studies, they do not provide analysis, but rather a factual description of events, dilemmas and figures.

Another extremely valuable and interesting source of information has been Lisa Endlich's book[33]. The book tells the tale of Lucent from its ancient history and founding to 2003, through the story of Henry Schacht and Rich McGinn and their leadership. Although the book does not provide much information about supply chain structures and practices, it does provide incredible amounts of information and insights about the industry, company and personal dynamics, all essential to understanding Lucent's journey. The book also provides insight into a company that, being caught up in the dot com bubble years, lost its way and values.

[32] David Hoyt, "Lucent Technologies: Positioning and Postponement - a Case Study," ed. Enrique Lopez-Tello (Stanford, CA: Stanford University Graduate School of Business, 2001), vol., ed. Hau Lee.
[33] Lisa Endlich, Optical Illusions: Lucent and the Crash of Telecom (New York: Simon & Schuster, 2004).

3 The Telecom business – an overview

3.1 History of the telecommunications industry

The telecommunications industry (telecom) has been providing its customers with means of electronic communication for about 150 years. The industry started out as a group of telegraph companies in 1856, called Western Union. As new technologies and applications were introduced, the industry evolved to include telephone and its infrastructure, mainly cable and call routing equipment towards the end of the nineteenth century and radio and microwave equipment during the first half of the twentieth century. During the second half of the twentieth century, television and cable TV, as well as long distance phone service providers were introduced. During the 1970s and 1980s, industry growth picked up considerably, along with advances in personal computing. Further fueling this growth was the introduction of the Internet during the eighties, as well as cellular telephony during the nineties, which in turn was fueled by or coevolving with fiber optics and wireless technology. The most recent remarkable wave of growth happened (and is still happening) during the late nineties with the shift to digital communication, enabling much better and faster data communications, with data including voice applications. This recent industry boom is visible both in breadth as well

as is speed of new innovations being introduced. Although the market is still reeling from the 2000/1 downturn and trying to recover, there is still significant growth, with worldwide market topping $1.3 trillion in 2003. Quoting Gartner Global Telecommunications Market Take Forecast 3Q04, the telecom market will grow at a compound annual growth rate (CAGR) of 6.1 percent to reach $1.7 trillion by 2008 (see Table 1: Worldwide Telecommunications Market Revenue by Region, 2002-2008). The services sector outpaced the equipment sector in size by a factor of more than 3-to-1, with revenue of $1.04 trillion in 2003, compared with $250 billion for equipment. By 2008, that proportion will hold steady; the services sector will achieve a CAGR of 6.3 percent, contrasted with 5.4 percent for equipment. Regionally, the largest market will remain North America (with a CAGR of 5.7 percent), while the Middle East and Africa will post the fastest growth worldwide (with a CAGR of 13.9 percent)[34].

3.2 Telecommunications Regulation

Although the telecommunications industry is a global industry, most of its growth through the years has been dominated by the US market, which is still the largest portion of the market, and projected to continue to be by 2008 (see Table 1: Worldwide Telecommunications Market Revenue by Region, 2002-2008[35]).

[34] Hahn, W. L., "Global Telecommunications Market Take, 3Q04 (Executive Summary)", Gartner Dataquest, October 12, 2004
[35] Ibid

Table 1: Worldwide Telecommunications Market Revenue by Region, 2002-2008

Worldwide Telecommunications Market Revenue by Region, 2002-2008 (Millions of Dollars)

	2002	2003	2004	2005	2006	2007	2008	CAGR (%) 2003-2008
Asia/Pacific	303,471	341,913	382,258	409,510	439,602	456,891	467,058	6.4
Growth (%)	6.7	12.7	11.8	7.1	7.3	3.9	2.2	-
Central and Eastern Europe	62,616	65,527	73,738	79,387	84,218	88,208	92,558	7.2
Growth (%)	25.6	4.6	12.5	7.7	6.1	4.7	4.9	-
Latin America	78,009	81,937	95,082	104,633	112,554	120,851	130,675	9.8
Growth (%)	-17.8	5.0	16.0	10.0	7.6	7.4	8.1	-
Middle East and Africa	53,124	63,673	74,655	85,617	96,735	109,754	122,124	13.9
Growth (%)	4.9	19.9	17.2	14.7	13.0	13.5	11.3	-
North America	388,994	401,818	424,788	449,702	480,036	508,539	530,669	5.7
Growth (%)	0.0	3.3	5.7	5.9	6.7	5.9	4.4	-
Western Europe	309,429	337,846	355,734	368,409	378,765	385,578	395,103	3.2
Growth (%)	2.8	9.2	5.3	3.6	2.8	1.8	2.5	-
Total Telecom Equipment	252,956	249,975	275,959	288,790	307,474	317,546	325,760	5.4
Growth (%)	-14.4	-1.2	10.4	4.6	6.5	3.3	2.6	-
Total Telecom Services	942,686	1,042,739	1,130,295	1,208,468	1,284,437	1,352,276	1,412,427	6.3
Growth (%)	7.8	10.6	8.4	6.9	6.3	5.3	4.4	-
Total Telecom Market	**1,195,642**	**1,292,714**	**1,406,255**	**1,497,258**	**1,591,911**	**1,669,822**	**1,738,187**	**6.1**
Growth (%)	2.2	8.1	8.8	6.5	6.3	4.9	4.1	-

Source: Gartner Dataquest (August 2004)

As the two companies this paper Focused (Cisco and Lucent) are both US based, industry regulation constitutes a major force shaping the industry.

The US telecommunication industry has been deregulated only relatively recently. For most of its existence, the industry has been heavily regulated. Following the expiration of the original telephone patent by A.G. Bell in 1884, there was a proliferation of small new telephone service providers, many with proprietary technology and infrastructure. Consequently, AT&T (at the time headed by Theodore Veil) lobbied congress for a “natural monopoly”, advocating overall benefits to all stake holders by standardization and the elimination of redundant infrastructure. AT&T proposed to allow competitors the use of AT&T infrastructure in exchange for regulated rates and protection from competition. By 1925, most long distance rates were being regulated, and in 1934 the FCC (Federal Communications Commission) was created, and the

Communications Act was passed. This communications act of 1934 regulated commerce in communication by regulating interstate and international communications, both wire-line and wireless.

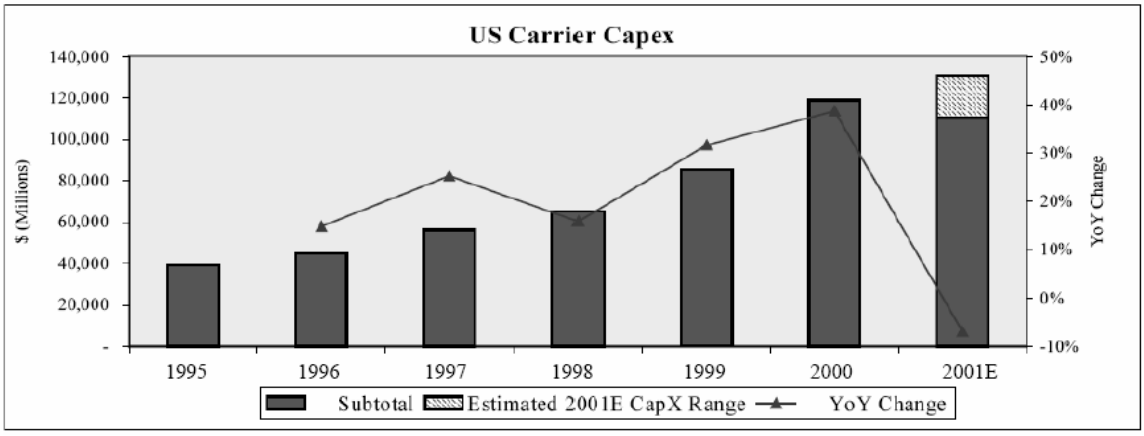
After a long anti-trust lawsuit, deregulation began in 1982, breaking up the AT&T monopoly in 1984 and opening up the long distance service market for competition. In 1996, it started to look as if a circle has been closed for the telecommunications industry. The passing of the 1996 Telecommunications Act enabled competition between local telephone companies, long distance carriers and cable TV operators, allowing each to enter all markets. As in the first days of the industry back in 1884, this caused thousands of competitors to enter the market (over three thousand new service providers entering the US market between 1996 and 1999[36]), as the prospect of high profit margins appealed to all. The availability of capital, coupled with a strategic view that necessitated diversification and intense competition, resulted in considerable spending on communication equipment and technology.

3.3 Bubble years

The aggressive spending by new telecom carriers, as well as by incumbent carriers seeking to upgrade, improve and expand led to the creation of overcapacity. This in turn caused the stockpiling of inventory, sometimes as a strategic tool used by equipment manufacturers to attract customers with product availability and short lead-times, and sometimes by misinterpretation and unavailability of demand signals. This

[36] Standard & Poor's, Industry Surveys, "Communications Equipment", VOLUME 167, NO. 51, SECTION 1, December 23, 1999

spending pattern was seen by service providers as the way to assure their survival by spending heavily on capacity for data driven communications[37]. Analyzed by Sanford C. Bernstein, a pattern of huge spending can be seen between the years 1997 and 2000 (see Figure 1 - US Carrier Capex pre-Bubble Burst). Capital expenditure (CAPEX) increased from $56-billion in 1997 to almost $120-billion in 2000, representing 33 percent of total industry sales of more than $350-billion and a year-over-year growth rate of more than 30 percent for both 1999 and 2000. By contrast, retail sales during this same period had grown in the neighborhood of 10 percent year-over-year. A segmented breakdown of the carrier CAPEX shows that new long distance backbone spending, making up 25 percent of the $119 billion total US carrier CAPEX, grew at a staggering 920 percent from $3.26 billion to $29.5 billion between 1997 and 2000[38].



Source: Bernstein, 2000

Figure 1 - US Carrier Capex pre-Bubble Burst

Several factors, trends and sentiments fueled this capacity building frenzy. Perhaps the most influential of those factors was the Internet bubble, which was at its

[37] Standard & Poor's, Industry Surveys, "Communications Equipment", VOLUME 169, NO. 3, SECTION 2, January 18, 2001

[38] Sanford C. Bernstein & Co., Inc., Bernstein Research Call, "Networking and Telecommunications Equipment", December 19, 2000

peak. Described by the chairman of the Federal Reserve at the time, Alan Greenspan, as "irrational exuberance[39]", the stock market sentiment and mentality drove high-tech, Internet and telecommunications stock values to all time highs, which enabled easy finding by public offerings and venture capital to be available to new entrants. Other factors included increased network capacity demand, both for data networks and voice networks.

Another factor contributing to equipment, service and upgrades demand was the anticipated Y2K software bug[40], which mainly caused demand for backup systems and software upgrades that had to be completed before 1/1/2000. Although some experts doubted the sustainability of such rates of growth, other experts believed the expansion would continue at rapid rates, with growth rates of up to 14%-15% annually[41].

3.4 Drastic change 2000

These optimistic trends failed to materialize. While capital expenditures continued to rise, retail sales rates were having trouble following suit. In addition, the carrier

---

[39] Remark made by Chairman Alan Greenspan to describe the source of "unduly escalated asset values, which then become subject to unexpected and prolonged contractions" at the Annual Dinner and Francis Boyer Lecture of The American Enterprise Institute for Public Policy Research, Washington, D.C., December 5, 1996

[40] The Y2K bug was a popular name given to an expected widespread software glitch - the result of early computer programmers choosing a two-character year field in many applications. Many experts believed that the calendar rolling over from 99 to 00 would be interpreted by software as meaning 1999 to 1900, with disastrous implications; for example, interest calculations. For more information see the National Year 2000 (Y2K) Clearinghouse at www.y2k.gov. This website is a combination of the President's Council on Year 2000 Conversion, the Chief Information Officer's Council Committee on Year 2000, and the U.S. Federal Gateway for Year 2000 Information Directories.

[41] Standard & Poor's, Industry Surveys, "Communications Equipment", VOLUME 167, NO. 51, SECTION 1, December 23, 1999

industry was accumulating debt, up to and over 91% of sales at the end of 3Q0042. With banks wishing to limit their exposure to the sector due to these high debt levels, equipment manufacturers and suppliers increased their client financing to stimulate sales. This funding was not only significantly greater than it used to be, but it was also used sometimes to purchase competitors' equipment. For example, according to Standard & Poor's, as of 3Q2000, Lucent Technologies had extended $1.5 billion in financing to its customers - more than double the $700 million sum for the comparable year-earlier period. During this same period Lucent's competitor Nortel Networks had extended a similar $1.4 billion in financing to its customers, a $300 million increase from the year-earlier period[43]. This was critical, as the supply channels were already overloaded with inventory that had to be kept in motion. In addition, the attempt at gaining market share and stimulating growth led equipment manufacturers to invest heavily in new technologies. This increase in investment on the part of the equipment manufacturers led to component shortages. The clients (service providers), fearful of product unavailability responded in turn by generating "phantom orders", padding forecasts on different supply tiers, leading to wrong inventory allocations and stocking, based on these inflated forecasts that were later to be cancelled. Some of the equipment manufacturers responded by changing their make/buy schemes, vertically integrating and increasing manufacturing capabilities, to reduce reliance on outside sources. As can be seen, this was a reinforcing positive loop that continued to fuel the growth.

---

[42] Sanford C. Bernstein & Co., Inc., Bernstein Research, Weekly Notes, "Technology Sector Strategy: Is This Cyclical Deceleration Different From The Past?", December 22, 2000

[43] Standard & Poor's, Industry Surveys, "Communications Equipment", VOLUME 169, NO. 3, SECTION 2, January 18, 2001

During 2000, overall economic growth rates declined, while installed network capacity far exceeded demand. The fact that the market was operating under bubble conditions became clearly visible. Investors were beginning to question the ability to return the investment in equipment and bandwidth, and orders were being cancelled or delayed. Inventories were starting to accumulate, causing equipment manufacturers to incur considerable holding costs, forcing price markdowns. However, although equipment manufacturers tried to curb production and delay new product launches to enable the selling of on-hand inventory, they were punished for that by stock markets, seeing this as a sign of weakness. By the end of the year, several industry giants have missed their revenue targets (Nortel in 3Q2000 and Lucent in Jan 2000), while others have issued warnings (Nokia, Motorola and Ericsson). The stock market responded accordingly, dropping the S&P Communication Equipment index by 56% in 2000, a shocking contrast with the 1999 129% increase.

3.5 Equipment manufactured

The two companies this paper looks at are first and foremost equipment manufacturers. Although they may choose to pursue virtual manufacturing strategies, or provide their clients with additional services like consulting, maintenance, "solution packages", and an opportunity to connect with their business partners, their reason for being is still the boxes they sell to their customers, or the software that runs on these boxes[44]. It is therefore important to understand what these pieces of equipment do and connect that with what customers need and expect.

If we imagine the Internet or the telecommunication networks (a very complex system which will not be discuss here) to be made of end nodes (computers), wires and information flowing, than the components that direct the flow of information from one computer to another and in between networks are routers and switches.

Routers: devices that forward data packets along networks. A router is connected to at least two networks, commonly two Local Area Networks (LANs) or Wide Area Networks (WANs) or a LAN and its Internet Service Provider's (ISP) network. Routers are located at gateways, the places where **two or more networks connect**. Routers use headers and forwarding tables to determine the best path for forwarding the packets, and they use protocols such as Internet Control Message Protocol (ICMP) to communicate with each other and configure the best route between any two hosts. Very little filtering of data is done through routers[45].

[44] More on the importance of hardware vs. software in the Cisco Strategy chapter.
[45] http://www.webopedia.com/TERM/r/router.html

Switch: A **network switch** is a computer networking device that connects different network segments. The switch receives a data packet and transmits it out again through the appropriate port (in the direction of the destination network segment), according to the address contained within the packet, which the switch reads. In case of an unrecognized destination, the switch simply forwards the packet out all of the connected interfaces except the incoming port. Intelligent switches learn the network structure and optimal ways to send data around, storing relevant information in tables and sharing these tables with other switches on the networks.

At the core of Cisco and Lucent's business are switches and routers. Although both companies make both pieces of equipment, it seems to be the case there are two different markets for these two products. For example, according to Infonetics Research data from 2004, in 2002, routers were responsible for $2.96 billion of worldwide switch and router manufacturers' revenues, as compared to only $2.33 billion generated by multiservice switches. By 2003, the gap has increased to $3.02 billion generated by routers while multiservice switches generated only $1.8 billion. These differences can be explained by the different customers buying these machines, different networks growth patters necessitating the use of these machines, uncertainty in the future of certain technologies and similar factors. Nevertheless, by the end of 2003, global switching and routing revenues were between $5.3 billion and $5.5 billion, shared

between Cisco (45%), Nortel (19%), Juniper (10%), Lucent (8%), Alcatel (6%) and others[46].

[46] "Worldwide Switching, Routing Market Shows Upswing". 2004. Industry Overview. Lightwave. (1/2004): PennWell. 10/8 2004.

4 The history of Cisco[47]

In 1984, Leonard Bosack, who headed the Stanford University Computer Science School Computer Center and Sandra Lerner who headed the Business School Computer Center were looking for a way to connect two computer networks at their university campus. At the time, networks were slow and clumsy, limited by their physical span and the lack of widely accepted communication protocols that would allow different networks to talk to each other. Bosack and Lerner, along with Greg Satz, Richard Troiano and Kirk Lougheed[48] endeavored to connect the two separate computer networks by actually running cables through campus and programming a computer to translate between the two different protocols the two existing networks were using internally. This concept was named "Internetworking", and is the basis on which modern computer communications is based on.

[47] Based on the following sources:

Bunnell, D., *Making the Cisco Connection: the Story Behind the Real Internet Superpower*, John Wiley & Sons, 2000

Paulson, E., *Inside Cisco: the Real Story of Sustained M&A Growth*, John Wiley & Sons, 2001

Waters, John K., *John Chambers and the Cisco Way: Navigating Through Volatility*, John Wiley & Sons, 2002

Cisco website: http://newsroom.cisco.com/dlls/timeline.html, 3/3/05

Hoover's: http://premium.hoovers.com/subscribe/co/history.xhtml?ID=13494, 3/3/05

[48] There is some debate among Cisco historians as to the role different people played in the company's inception. As these details are immaterial to this work, the following history is based on the abovementioned sources without taking a stand for or against specific claims. Among the people who were involved in the first stages of the Cisco project were: Benjy Levy, Jeff Mogul, Steve Novicki and Bill Yeager.

Cisco's early history has been widely discussed and documented. However, it is sometimes hard to tell hard facts from lore. Nevertheless, whatever Bosak and Lerner's vision might have been, it is clear they had the vision of Internetworking being in demand. They took a second mortgage on their house and opened as many credit card accounts as they could to found Cisco, named after San Francisco.

Interestingly enough, the first Cisco product was not a server or a multi-protocol router, but rather a network interface that allowed DEC stations to connect with Stanford's Ethernet system.

In 1986, Cisco sold its first router to HP and the University of Utah. This product, called the "Advanced Gateway Server" (or AGS, and later AGS+) dealt with IP and Xerox PARC Universal Protocols (PUP). However, as word spread in the technical community of this product, more and more requests came in for Cisco to incorporate more protocols into the AGS. According to Cisco historians, it is possibly this willingness to incorporate more protocols that drove Cisco's success. This is evident to this day in Cisco's culture. In a conversation with a senior executive at Cisco, he defined Cisco as "standard agnostic", willing to support whatever standards and protocols its customers requested.

However, Cisco's "standard blindness" was augmented by new protocols developed by Cisco itself, such as the Interior Gateway Routing Protocol (IGRP), the first protocol to permit the building of large Internets, developed in 1987. The same year, Cisco received a vote of confidence from Sequoia Capital, in the form of $2M venture capital. These $2M bought Donald Valentine of Sequoia Capital a controlling stake at the

company, making him chairman. Valentine then proceeded to hire John Morgridge of laptop maker GRiD Systems as president and CEO in 1988. That same year, Cisco ships the Multiport Communications Interface (MCI), the highest speed network interface in the industry at that time that could do bridging and routing concurrently. As far as extending Cisco's customer outreach goes, in 1988 Cisco established the "email lifeline" email account, to which everyone in the company subscribed (customerservice@cisco.com). This enabled Cisco to solve customer problems in real time, transforming customers into colleagues through very close relations with the developers and an actual involvement in the problem solving process. In addition to using email for customer service purposes (which was leading edge at that time), Cisco also accepted orders through email, as well as posted software images on File Transfer Protocol (FTP) servers, to be picked up by customers in real time. This would be a precursor to Cisco's use of e-business practices.

In 1990, Cisco launched its Networkers Users Symposium, which facilitated the creation of a growing "community" of technologists, researchers, developers and users. The same year, Cisco goes public on February 16, listed as "CSCO" on the NASDAQ, with a market capitalization of $224 million.

By 1991, the Cisco operating system (IOS – Internetworking Operating System) was loaded on all Cisco products. This was done to ensure compatibility across a wide range of network products. As company Internetworks grew in scope and complexity, customers would become more and more dependent on the IOS software. According to an account by Dave Cavanaugh (Engineering Education Manager), during this period of time around 1992, Cisco was releasing a major release of IOS every 3-4 months, on a

timeline basis. This meant features that were ready on time were included in the released version, while other features and bug fixes that were not ready on time were folded over to the next release. This would prove important later on, as will be discussed in the strategy analysis.

In 1993, Cisco made its first acquisition of Crescendo Networks, a LAN[49] switching company. The following year, 1994, Cisco defined acquisitions not as a one time event but rather as a strategic business process that would allow it to rapidly enter where it lacked product availability. This meant Cisco was not looking to buy products. Rather, they were looking to get new technologies and incorporate them into the Cisco offering. If a technology could not be licensed or if the technology owner could not be partnered with, the company will be acquired. This meant not only putting in place processes to integrate the newly acquired technology, but also the people, creating a well-defined procedure for the assimilation of the acquired company, its business processes, accounting, protocols etc.

According to Carl Redfield, senior vice president manufacturing and logistics at Cisco, by 1994 Cisco started looking into "Virtual Manufacturing", and "Direct Fulfillment". According to Redfield, there began to grow a sense that manufacturing and labor management were not necessarily one of Cisco's core competencies. Rather, Cisco viewed engineering and design, along with managing the supply base as important core competencies. The right design, processes and material control could allow a supplier to

[49] LAN: Local Area Network. A geographically localized network consisting of both hardware and software. LANs link personal computers, workstations, printer file servers, and other peripherals. Devices on a LAN typically transmit data inside buildings or between buildings located near each other (HTC Technical Dictionary: http://www.htcinc.net/dictionary/dictionary.htm).

build a product with designs, materials, processes and test processes provided by Cisco. Within the first year, Cisco was shipping 25% of revenue through these kinds of processes. However, it is important to note that by 1994, Cisco was growing more than a 100% per **quarter**, with new platforms added at dramatic rates and product complexity growing. It is probably safe to assume that these factors, the growing demand and complexity as well as the rethinking of core competencies, contributed to the decision to build the virtual manufacturing process.

In January 1995, John Chambers was appointed CEO, Larry Carter was appointed CFO and John Morgridge was appointed Chairman of the Board.

Although the company was growing at an amazing rate, Cisco leadership was looking to try and retain the advantages of a small company. To achieve that, Cisco was organized into five business units: Core, Workgroup, ATM[50], Access, and InterWorks (for IBM integration).

By 1996, Cisco's sales pitch was based around selling end-to-end enterprise wide solutions, rather than point products. In addition, Cisco was driving the vision of the network as a strategic asset, rather than an operations expense. To that end, Cisco marketing was targeting sales calls at the CIO level. In addition, Cisco used its own Information Technology (IT) group. Cisco used its own web applications as a showcase for Internet leveraging possibilities. Cisco also shared the lessons learned while implementing those systems with their clients and partners. Deploying their own

[50] Short for Asynchronous Transfer Mode, a network technology based on transferring data in cells or packets of a fixed size. The cell used with ATM is relatively small compared to units used with older technologies. The small, constant cell size allows ATM equipment to transmit video, audio, and computer data over the same network, and assure that no single type of data hogs the line.

technologies around the globe to support these applications, Cisco was actively working to refute the traditional view of IT as an operations expense.

In 1997, Cisco introduced its Cisco Networking Academies program, providing high school and college students, as well as corporate clients with Internet technology skills. By doing this, Cisco put to action its belief not only in the value of its own human capital, but also in the value of its clients' human capital as a resource to be leveraged. Through an initial investment of $18M, Cisco was looking to create a growing consumer base for its products and services and align itself with academic institutions and schools. This program proved a success, with more than 130,000 graduates worldwide, as well as 400,000 students and 10,000 academies in 150 countries by 2004.

In 1998 Cisco formed its Internet Business Solutions Group (IBSG), which provided customers with business consulting services. According to Charles Stucki, VP of IBSG Manufacturing Vertical at Cisco, businesses were realizing the strategic potential of Internet technology, which allowed Cisco to leverage its own experience with using the Internet strategically and help customers with building the required business processes to enable such uses. These business processes included not only information sharing for manufacturing and design, but also supply chain management and efficient and creative logistics practices. According to Richard Kelly[51], director of business process re-engineering at BP Chemicals and John Legatte[52], Digital Business group VP at BP, the main reason for selecting Cisco as a partner in the business process re-engineering effort was the fact that Cisco has actually gone through such an effort

[51] Testimonial, available on the Cisco web site, http://www.cisco.com/warp/public/779/edu/cisco20/cisco20.html, accessed 3/10/04.

themselves and were speaking from experience. Furthermore, the consulting focused not on the technology but rather on the creative and excellent use of such technology. This view is seconded by Horst Schaefer[53], Western Europe country group manager for ABB, who speaks of learning best practices from Cisco, based on what Cisco have already done in-house for themselves.

By 2000, most businesses were using the Internet. It became clear that security was an issue that needed to be addressed. That year, Cisco released several security products such as firewalls, as well as a security blueprint for businesses. Leading an effort to minimize total damage done by cyber-attacks, Cisco led the consolidation of NSP-SEC, a consortium of service providers' security engineers. On March 27th that year, Cisco became the world's most valuable company with a high market cap of $569B, closing at a market cap of $555B.

In recent years, Cisco has been entering the wireless markets (with the Linksys acquisition in 2003), as well as the IP telephony and converged communication/voice/video solutions, which can be wireless enabled as well (for a more recent snapshot of Cisco, see Table 2- Some Facts and Figures). This move was mentioned by some Cisco executives interviewed and will be discussed later in the strategy analysis.

[52] Ibid.
[53] Ibid.

Table 2- Some Facts and Figures

Cisco has just one Cisco owned manufacturing facility
Cisco has about 25,000 SKU's, 40% of which are hardware, the remaining 60% software
Cisco has 50,000 active part numbers
80% of these parts' procurement is outsourced, and 100% of the material management as well
Cisco has 270 active suppliers, with 90% of business concentrated with 90 suppliers
In the span of four years, assembly and test was massively outsourced. From 55% outsourcing to 90% by revenue, 98% by volume
100% of Cisco's fulfillment (transportation and logistics) is outsourced to 3PL
Overall, for every Cisco employee, there are six outside employees involved in the manufacturing, test, assembly and fulfillment process
Cisco is organized around 3 "plants", or product categories (aligned with commercial products, enterprise and service providers – the same historic lines of business previously described). The low end generates about 40% of the revenue, while the mid range and high end generate about 30% of the revenues each

5 Cisco strategy

This chapter aims at understanding Cisco's strategy. Although this aim seems straightforward, gaining a true understanding of the company's strategy is not as simple as it seems, as the company's actual strategy is opaque to outside research for several reasons.

First and foremost, the overt strategy declared openly is oftentimes not exactly the strategy the company chooses to follow, for competitive advantage reasons. In addition, although there might be an overarching strategic framework under which all parts of the company are supposed to work, different units within the company have different goals to meet, causing each unit to react to the outside world accordingly. This would cause (even under the assumption that all business units are indeed following corporate strategy) different business units to view this strategy through a different lens, interpreting it to fit what the specific unit feels like would best serve its goals and protect it from risk.

In Cisco's case, this paper draws on several different sources trying to paint a coherent and as-accurate-as-possible picture of the company's strategy. These sources include interviews with Cisco personnel, analysts' reports, literature and a critical look at the way Cisco is actually doing things. However, since understanding Cisco's supply chain architecture is the main topic of this research, this paper focuses on those aspects of strategy which affect the way Cisco views, designs and runs its supply chains.

Cisco's main strategic goal is to become (or remain) the leader of end-to-end enterprise network solutions. Cisco tries to maintain not only the lion's market share, but also keep profit margins high. This also means Cisco does not concentrate on being in the forefront of technology with niche products. They do however concentrate on being the first (and largest) to incorporate such new technologies into their end-to-end solutions, through three main endeavors: concentrating on software, mindfulness of standards and their importance (resulting in what will be referred to as "platform leadership"), and aggressive acquisition tactics.

5.1 The move to Software

Looking at Cisco from the outside, there seems to be a good match between the shift in sales from hardware to software, as well as the budget allocated towards software R&D (25%-35% of $3.5B R&D) and the hardships Cisco faced in 2000-2001 caused by the bullwhip effect and the buildup of excess inventory.

As software by nature is not bound to hardware, but can rather be easily transported via the network anywhere in real time (which in fact is done for non-application pieces of data, such as documentation which is available both online and in hard format), it would not be susceptible to the bullwhip effect, since there is no inventory of software.

Actually, there can be an inventory of software. However, it can be burnt on standard media (CD, DVD etc.) at very short notice, the standard media is very cheap to hold, it takes up very little space and can be mailed anywhere in 24 hours. One factor that could possibly complicate things up a bit is the cover printing for the software, but that is

a relatively small hassle (a customer in a rush will be willing to accept a CD without a proper sleeve). Overall, about 15,000 parts out of Cisco's offering of 25,000 parts are software, with the majority of software being physically fulfilled, along with documentation and licensing, being configured to order[54].

However, when talking to Cisco management, a different picture emerges. There has been no conscious strategic supply chain move from hardware to software, especially not as a means to mitigate bullwhip. Rather, Cisco has always been about selling software, with the hardware being only an afterthought. To elaborate on this point, in the Cisco products (such as routers, switches, etc.), the intelligence, features and functionality reside in the software. It is the software that performs the required tasks and the software that differentiates products from one another. All important actions performed by the Cisco product on the data that goes through it are logical actions, with the physical actions (such as directing a piece of data down a specific wire) being only a consequence of the advanced logical operations performed according to and on those pieces of data.

Accepting that the move to software is not supply-chain driven means it is rooted in other reasons. Such reasons might include features added to products due to new markets entered (like call management), the growing complexity of networks and communications, additional requirements put on Cisco products by users, without which Cisco would have trouble selling its products (like security features), as well as attempts by Cisco to shift functionality and intelligence that used to reside in other parts of the computing environment (like load balancing, redundancy and doling out work to different

[54] Miller, Jim. February 2005 interview.

parts of server farms) to the network elements (which Cisco sells) and the network itself (which Cisco's software partly manages).

The increase in software importance does not come without costs. Cisco IOS (Internetworking Operating System), the main software product Cisco sells that is installed on every Cisco router and switch has grown into a giant piece of software. Over 30,000,000 lines of code prove to be virtually impossible to debug or change, requiring thousands of engineers to work on software customization to meet specific requirements and needs. In addition, the IOS software has become the number one complaint from customers. Although the overall software quality keeps going up (defined by something like a $\frac{Lines}{Bugs}$ metric), the actual number of bugs keeps rising due to the fast increase in lines of code. Of course the customer should not care (and not even know) about the size of the software inside the Cisco product, but only about its quality.

5.2 Platform Leadership[55]

Cisco is no different than any other company in the fact that it needs to maintain a competitive advantage over its rivals over time. Cisco strives (and succeeds) to dominate its markets not only through fulfilling the need for its products, but also through creating that need with the creation of demand for more bandwidth. To that end, Cisco uses its partnerships as well as its internal resources, generating industry-wide growth, with the industry being the telecommunications and data communications markets.

According to a senior Cisco execituve, one way in which Cisco pursues industry growth is by being standard agnostic. This means Cisco neither excessively tries to push to clients its own standards, developed in-house, nor does it limit its product offering to currently supported standards. In fact, Cisco is known as an early adopter of various standards, willing to incorporate such standards (which might be proprietary to a single client or client alliance) into the list of communication protocols handled by its products. One of the factors contributing to Cisco's ability to do this is their very close relations with their customers, which will be elaborated on later. It is however important to mention that Cisco's free consulting services are not only providing customers with valuable insights, best practices and support, but it also enables Cisco to get demand, technology trends and customer need signals sooner than they might have otherwise been able to.

[55] Based on the concept introduced and developed by Annabelle Gawer and Michael A. Cusumano.
Gawer, A., Cusumano, M. A., *Platform Leadership: How Intel, Microsoft and Cisco Drive Industry Innovation*, Harvard Business School Press, Boston 2002

In addition, Cisco views standard-setting bodies as slow-moving bureaucratic organizations. Although these organizations have an important purpose to serve in helping create unified (and better) methods of communication, they also serve as regulators, sometimes artificially inhibiting potential growth. Cisco does not view membership in standard organizations as a strategic differentiator, and is therefore not as influential within such bodies as it could have been.

However, Cisco's view should be augmented by historic facts. These facts seem to indicate Cisco in fact recognizes the importance of close involvement in the processes of standard setting, keeping a very close watch on developments in the field and perhaps even trying to influence such developments to its advantage. Such an indication might be Cisco Fellow Fred Baker being named chairman of the Internet Engineering Task force in 1996, a role he maintained through 2001, when he was replaced by another Cisco Fellow, Harald Alvestrand. According to the IETF website[56], The Internet Engineering Task Force is a large open international community of network designers, operators, vendors, and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet. The actual technical work of the IETF is done in its working groups, which are organized by topic into several areas (e.g., routing, transport, security, etc.). IETF is also providing architectural oversight with the Internet Architecture Board (IAB). It also includes the Internet Assigned Numbers Authority (IANA), which is the central coordinator for the assignment of unique parameter values for Internet protocols. The IANA is chartered by the Internet Society (ISOC) to act as the clearinghouse to assign and coordinate the use of numerous Internet protocol parameters. A document

[56] http://www.ietf.org/overview.html, accessed 3/28/2005

written by Scott Bradner, a technical assistant at the office of the president and provost at Harvard University (can be found on the IETF website[57]) describes the active role which this organization actually has in shaping Internet standards and practices. Quoting from the document, "This memo documents the process used by the Internet community for the standardization of protocols and procedures. It defines the stages in the standardization process, the requirements for moving a document between stages and the types of documents used during this process. It also addresses the intellectual property rights and copyright issues associated with the standards process." In 2002, Fred Baker was named chair of the Internet Society's (ISOC) Board of Trustees[58]. According to the press release, "The organization functions as the international focal point for global cooperation and coordination in the development of the Internet, and provides global leadership in the area of Internet standards, education, and policy development issues".

In 1998, Cisco opened its government affairs office[59], which helped lobby for issues which Cisco held dear. According to the press release and quoting John Chambers, Cisco's president and CEO, "With networking technology so important to our nation's business, education and export sectors, we believe it is vital to foster a positive dialogue between industry and government. Opening an office on Capitol Hill continues our efforts to build bridges between Silicon Valley and Washington. We want to see a two-way process of industry educating government about technology issues, and government educating industry on how to be a good partner." These moves were later aligned with

[57] http://www.ietf.org/rfc/rfc2026.txt, accesses 3/28/2005
[58] http://newsroom.cisco.com/dlls/corp_080502.html, accessed 3/28/2005
[59] http://newsroom.cisco.com/dlls/corp_042998.html, accesses 3/28/2005

security and encryption litigation being marked as key issues to be pursued by Cisco in its dialogue with the powers that be.

Although Cisco seems to be very quick and responsive in adopting and incorporating new standards without waiting for those standards to become officially endorsed by standard bodies, claiming these bodies are too glacial-paced, Cisco does seem to be very much involved with such standard bodies. Nevertheless, Cisco has much to gain by influencing network users and their behavior. According to Lawrence Lessig, a professor of Law at Stanford Law School and founder of the school's Center for Internet and Society and a prominent writer, user behavior can be altered by laws, as well as by the actual architecture of the networks used, more specifically by the communication protocols used by those networks[60]. In his book *Code and Other Laws of Cyberspace*, Lessig argues commerce on the web is a major driving force shaping Internet regulation due to security concerns, intellectual property issues, etc. He also suggests that for these reasons, the government should understand the value of regulating code architecture and help push desirable changes in code, which seems to fit well with Cisco's apparent attempts at lobbying Capitol Hill.

[60] Lessig, L., *Code and Other laws of Cyberspace*, Basic Books, 2000.

5.3 Mergers and Acquisitions (M&A)

With twelve years of aggressive M&A moves and more than one hundred companies acquired, M&A seem to be a major part of Cisco's strategy, deserving special attention. Cisco does not focus on selling boxes or devices, but rather on selling architectural end-to-end solutions, for example networking and security solutions all bundled up into one seamless system. Although there is a market for end-to-end solutions, this strategy often puts Cisco at a position where their first-to-market ability is hindered for specific "killer applications". Smaller, nimbler companies can maintain a sharper technological edge than Cisco can, due to Cisco's size as well as to the type of solutions Cisco has decided to focus on. Nevertheless, even in cases when Cisco is not the first-to-market with a new technology, they are the first to integrate these technologies into their product offering. Cisco is consciously attempting to lead the integrated product front, not the point product one.

In addition, Cisco is not profit margin driven as other companies are, but is rather growth driven, growing at 3-4 times the industry growth rates. To achieve the desired growth rates, Cisco uses R&D, M&A and investment, as well as using its brand name as leverage to enter new markets. This is necessary as Cisco realizes the switch and router business has limited potential, and growth into other areas is necessary to maintain its impressive growth rate. Such markets might include Direct Subscriber Line (DSL), Video-on-Demand, personal telephony applications, etc. For example, Cisco is using its brand name to enter the home wireless/wired networking niche with the Linksys product line. The wireless home niche seems to be generating an overall impressive amount of

network traffic, as private network users (home users) with a laptop and a wireless router seem to be using the web twice as much as home users without a laptop and a wireless connection[61]. Although the causal connection between the two is hard to show, the correlation exists nonetheless.

Simply put, Cisco describes its M&A strategy as complementing its "first to integrate" tactics. Once a critical technology has been identified by Cisco, they try to partner with the company owning this technology. In cases where for whatever reason partnership is not possible, Cisco would try to license the technology. If that is not possible either, Cisco would than try to acquire the company. It is important to emphasize that Cisco does not buy boxes (platforms) from other companies, but is rather interested in the technology itself and in the opportunities to embed this technology into Cisco's products.

After a company has been acquired, Cisco has a rigorous plan of integration, facilitating the assimilation of the newly acquired company into Cisco with minimum impact on Cisco and its culture.

[61] Schadler, Ted, "Laptops and Home Networks Transform Behavior", research document, Forrester Research, May 27th 2005

6 The Catalyst4000 (C4K) Supply Chain[62]

When looking at Cisco and trying to better understand its supply chain practices, a specific product supply chain was selected, that of the Catalyst 4000. As will later be shown Cisco has many different supply chain configurations suitable for its different products and customer segments, making it impossible to paint a comprehensive and complete picture of all of Cisco's supply chain practices within the scope of this paper. Hence, a representative product was chosen, which exemplifies many of the things Cisco does elsewhere. The Catalyst 4000 (C4K) is one of the largest business units in Cisco, bringing in $1.5 billion a year, with about 60% of the revenue generated by new product introductions (slightly higher than the Cisco average which is about 30%-40% new product introductions every twelve months). The following is a description of the C4K family from Cisco's web site, along with a picture of the actual product (Figure 2 - the Catalyst4000).

> "The Cisco Catalyst® 4000 Series of modular switches include the Cisco Catalyst 4003 and Catalyst 4006 chassis. As a key component of Cisco AVVID (Architecture for Voice, Video, and Integrated Data), the Cisco Catalyst 4000 Series extends control from the backbone to the network edge with intelligent network services including advanced quality of service (QoS), scalable performance, comprehensive security, and simple manageability. The modular architecture, media flexibility, and expandability of the Cisco Catalyst 4000 Series enable a longer deployment life in converged networks. A

[62] All data in this chapter is from interviews with Cisco employees.

longer deployment life reduces the overall cost of ownership by minimizing recurring operational expenses and also improves return on investment (ROI).[63]"

Figure 2 - the Catalyst4000

Although the Catalyst 4000 is an actual product family, Cisco's way of doing things is matrix based. This means people from all over the company, in all different functions and departments are responsible for the C4K's supply chain and product, rather than having a standalone business unit which includes all functions internally. Consequently, the relevant functions are highlighted in

Figure 6 - Cisco Organizational Chart, provided at the end of this chapter[64].

There are several reasons why the C4K supply chain was selected as a case study for this paper. Although different products within Cisco have different supply chains (about 5 or 6 totally different supply chains, according to Cisco), this product's supply chain should be representative of most work currently done within Cisco, both by volume as well as by product breadth. Following in the Cisco Organizational Chart is a more detailed description of the mid-range plant organizational structure, which the C4K is a part of. It is important to note that Cisco uses the term "Plant" to describe the virtual

[63] Except this: Cisco Website: http://www.cisco.com/en/US/products/hw/switches/ps663/

business unit under managers, rather than referring to an actual physical plant. In addition, this product also serves as a test bed for implementing some new supply chain concepts and practices within Cisco, such as the Cisco LEAN project. Some of the reasons for choosing this product's supply chain to conduct these pilots on are the fact that it is the lowest cost plant and one of the highest quality ones, while always making its numbers.

The Mid Range plant has overall 281 people in it. Of these 281 people, about half are dedicated to new product introductions, working closely with other units across Cisco such as product development; while the other half is dedicated to sustaining current activities in the plant.

6.1 Supply Processes

The C4K product's entire volume is manufactured by Cisco's Electronics Manufacturing Service (EMS) partner, Jabil, either in Hungary (which facilitates EU sales, as it has the "Made in EU" sticker attached to it; around 5% of production), Malaysia (Penang, 90%-95% of production), or the U.S. (Florida, which used to be the major supplier, now producing about 5%, mostly new product introductions). However, Jabil (Penang) is also responsible for manufacturing many other products, including mid range and low end routing, mid range switching, shared point adapters, optical equipment and transceiver modules. The C4K, along with the other products manufactured by Jabil, constitutes about 10% of Jabil's revenues, making Cisco Jabil's third largest customer

[64] This org. chart does not fully represent the entire Cisco organization, nor does it fully depict each individual's complete roles and responsibilities. Rather, it intended to show the way the C4K product is positioned within the company, the supporting organizational structures and relevant functions.

(with 80% of Cisco's business with Jabil generated by the mid-range plant). This percentage is purposefully kept under 40% for strategic reasons, as Cisco perceives danger in constituting more than 40% of a contract manufacturer's business. However, each of these products is under the responsibility of a different Business Operations Director (inside Cisco), with his or her own data and metric requirements, interfaces to Jabil and corresponding organizational structures, at times generating a wholly different business model for some of these products. This causes some of the contract manufacturers to push back in an attempt to rationalize the relationship, depending on the contract manufacturer's culture (and the incentive structure – which is currently based on volume, causing massive board reworks that later might cause quality issues). Each contract manufacturer has monthly operational reviews, quarterly performance reviews and annual or bi-annual strategy sessions with Cisco. In cases where the push back is low, Cisco sometimes tends to "love its partners to death", rewarding good performers with increasing breadth and volume to the point where they stop over-performing, and sometimes collapse, as they cannot cope with the increased work volume commissioned by Cisco with the same efficiency.

For parts sourcing, Cisco controls the strategic parts, including specification, negotiations and supplier split. However, Jabil selects and interacts with suppliers for all other components (about 80% of components). Another interesting fact brought up by one Cisco manager is that never was there a real component or capacity shortage that caused problems in production; Cisco and its partners have always found a way to locate the needed components or to allocate the required capacity. Rather, the bottleneck lies in

inefficient communications over the supply chain, which can delay an operation for 1-2 weeks.

6.2 Customer Processes

Despite the image projected by Cisco, that all orders are received through Cisco's online system, only about 20% of total revenues are generated by direct orders to Cisco from the end customers, while the remaining 80% of revenue are generated by orders received through Cisco's distributors. These direct orders also include service contracts, which otherwise would be set up (usually) between the end customer and the distributor.

60%-70% of orders for the C4K come through the distributors' channel, where assembly to order is done according to the distributors' perceptions of what customers might need and the level of service the end consumer is buying from the distributor, and not necessarily according to the customers explicit wishes (see Figure 3 - Cisco's Information Flow); these wishes are sometimes opaque to Cisco.

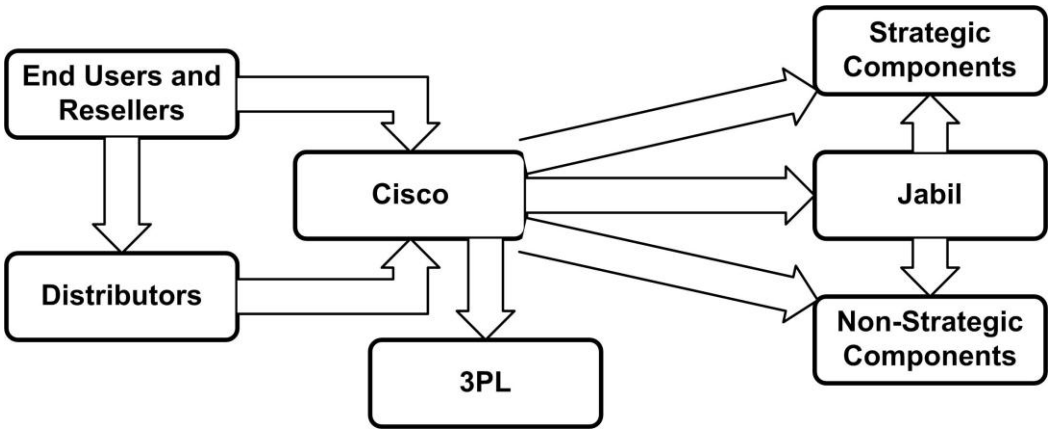


Figure 3 - Cisco's Information Flow[65]

The fact Cisco does not have sufficient visibility into the end customers' patterns of behavior and data, caused Cisco to consider improving their access to this data through the implementation of a new Oracle system. Nevertheless, Cisco has complete inventory visibility into their distributors' inventory, in fact controlling this inventory to the point of refusing to sell to distributors holding excess inventories (a quarterly review session looks at each distributor). Still, as each distributor receives credit from Cisco towards the purchasing of Cisco products, withholding on supplying additional goods which the distributor already holds in stock might make it easier for Cisco to push newly introduced products down the channel. This is important as about 60% of revenues for this product line are generated by new product introductions. In addition, distributors can return products freely, paying only a nominal stocking fee for such returns.

[65] Although information is a bi-lateral concept (for example, when informing suppliers of demand for parts, information regarding the availability of those parts is returned, with price and delivery schedule negotiations being a two way street), the diagram represents the general flow of the demand signal across the supply chain.

Another interesting practice is Cisco not recognizing revenues from sales of products to its distributors, which is a very conservative accounting practice. Cisco only recognizes 20% of the revenues at the time of the sale to the second tier distributor, and the rest is recognized only at the time of the final sale to the end customer.

As soon as an order (for a C4K) is received and committed to, Cisco schedules all aspects of the order (manufacturing, warehousing, shipping etc.) with the goal of delivering the order within a timeframe of 21 days. Cisco currently holds a service level of around 90% on the 21 day commitment level (with a 97% service level goal). From a company standpoint, this is done to ensure a stable building pace and backlog that would dampen ups and downs in demand, as Cisco does not perceive customers as needing/demanding shorter lead times, but rather as valuing consistency in lead times. Nevertheless, in case of pressing need, customers can approach Customer Service and request an expedited delivery (up to 20% of products are expedited). When a ship date is missed (for any reason) the specific order is analyzed. However, there are no constantly monitored metrics to ensure statistical process control on the lead times, to which all members of the supply chain must adhere. This miss-analysis is done throughout all aspects of the order fulfillment, including production and 3PL's.

6.3 Production Management

The production floor managers follow a build window of 8 business days, with the option of extending this window to 13 days without risking missing the delivery date. Manufacturing is starting to follow a Cisco Lean pilot program, utilizing a pull system with Kanbans, along with the legacy push system driven by demand forecasting and

planning. However, as this is only a pilot program, it is executed manually without automation beyond spreadsheet work (which is mostly relevant to the first tier suppliers). Naturally, there is a tradeoff between running such a pilot with the proper tools already in place (with some of these tools needing adjustment or not effective) and running the pilot first in order to collect the data required to build the proper tools. However, the lack of automated tools for this project (besides Excel spreadsheets), including custom metrics and a "control dashboard" proves to be very difficult.

After production is complete (including assembly and test), the product is sent to a "Strategic Logistics Center" (SLC), there to await shipment to customer sites (for material flow, see Figure 4 - Cisco's Material Flow). These SLC's (of which there are about 6 worldwide) are operated by a single Third Party Logistics Provider (3PL) and serve both channels; the "order directly from Cisco" and the "order through distributor". The interface with the 3PL is currently being examined in a pilot program referred to as "The Virtual Logistics Network" (see
Figure 6 - Cisco Organizational Chart). As for current standard operating procedure, nothing is shipped directly from Cisco to consumers, but rather from Jabil through these SLC's to the customers (or distributors), where Cisco does not touch the product, but acts only as an information junction and management function.

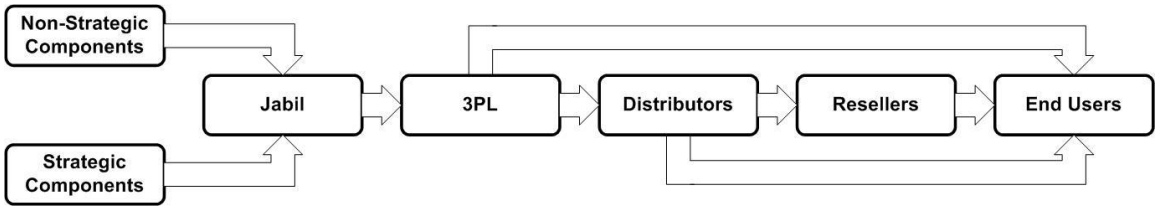


Figure 4 - Cisco's Material Flow

An overall view of Cisco's supply chain, information and material flow, shows clearly how the actual raw materials and products circumvent Cisco, with Cisco actually acting as an information hub, orchestrating the entire supply network (Figure 5 - Simplified C4K Supply Network (Goods & Information)).

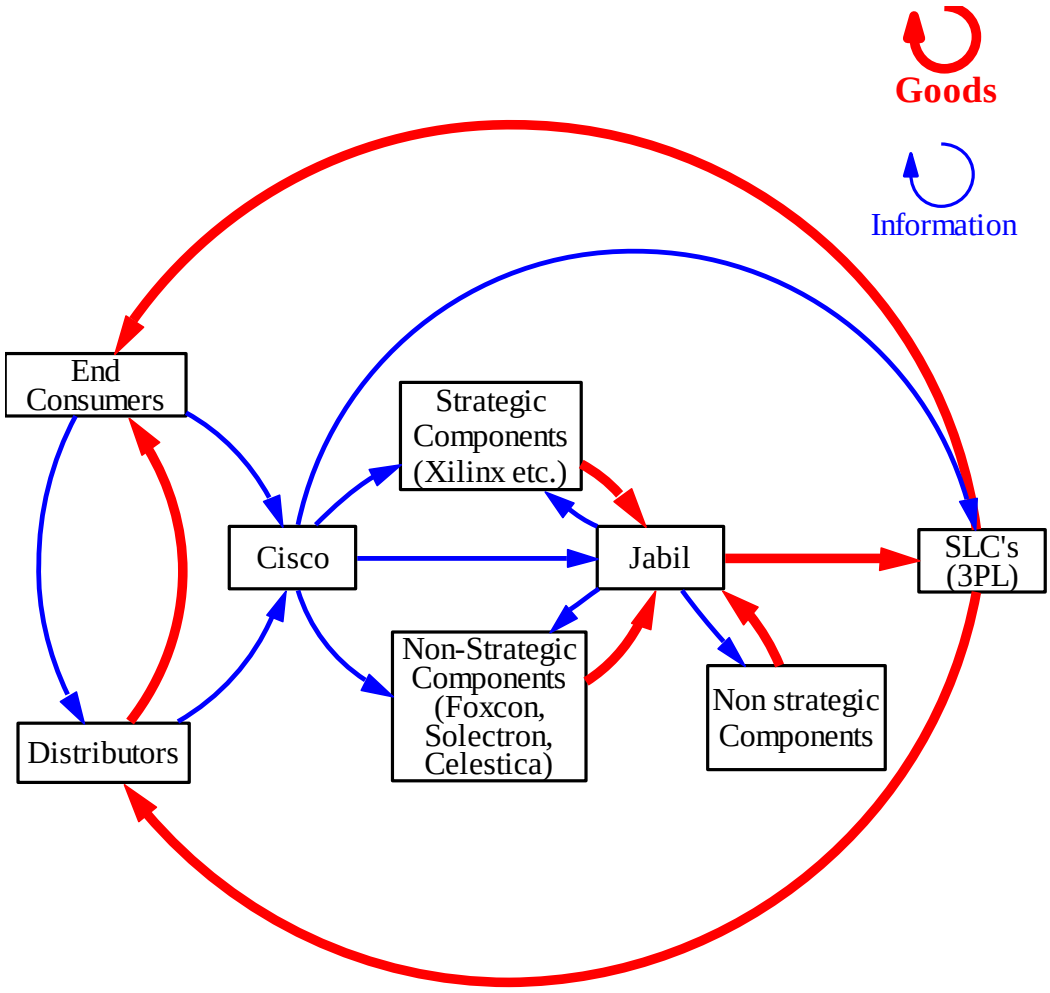


Figure 5 - Simplified C4K Supply Network (Goods & Information)

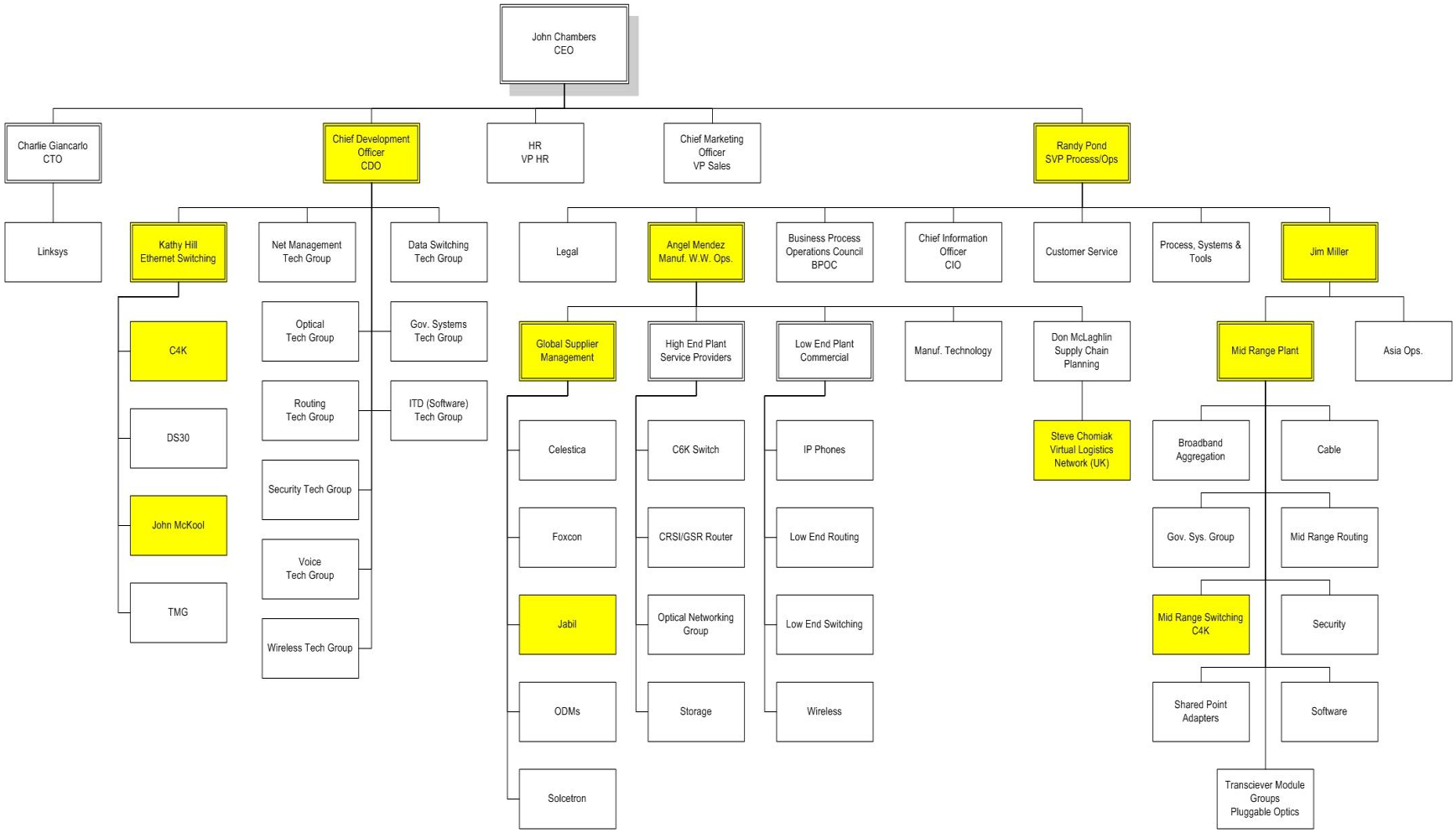


Figure 6 - Cisco Organizational Chart

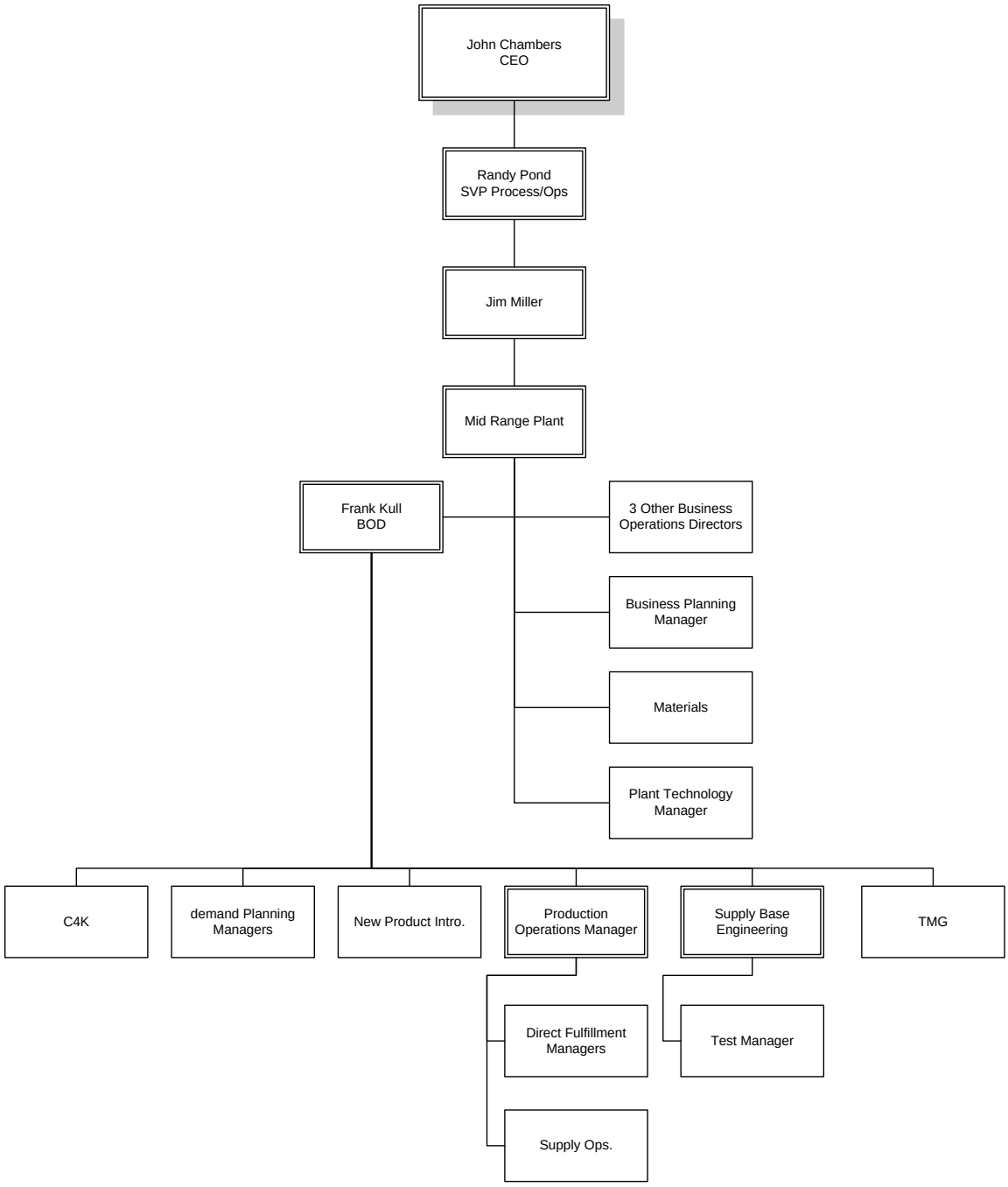


Figure 7 - Mid-Range Plant Organizational Chart

7 The history of Lucent[66]

Lucent's history is closely tied to the telecom industry's history, as it is an offshoot of AT&T, a company which has dominated the North American telecom scene for most of its life. Although many of Lucent's traits and strategies can be traced far back to AT&T historic reliance on in-house R&D (in its Bell Laboratories) and its corporate and bureaucratic structures, Lucent Technologies' existence as an independent entity started to emerge in the late 1980s. In 1984 a Justice Department antitrust ruling forced AT&T to break into seven regional operating companies. This signaled to AT&T a change in its business environment (this is elaborated on in 3.1 – History of the telecommunications industry). In an attempt to better serve the different needs of its customers and maintain strategic positions, AT&T Technologies branched into several business units in 1989, which included AT&T Network Systems, AT&T Global Business Communications Systems, AT&T Microelectronics, and AT&T Consumer Products. These units would later join forces with Bell Labs to form Lucent Technologies. This move appeared to have been the right move at the time, as these business units did in fact manage to better AT&T's U.S. market position and even exhibited double-digit international growth.

However, the growing market, as well as internal complexity led in 1995 to the decision to completely restructure the company. In 1995, AT&T came up with a proposal to form three

[66] Based on the following sources:
Endlich, L., *Optical Illusions: lucent and the Crash of Telecom*, Simon & Schuster, 2004
Scholz, D., *Luscent SCN: Leveraging the Fully Integrated Supply Chain*, Master of Engineering in Logistics Thesis, MIT ESD, 2004
Lucent website: http://www.lucent.com/corpinfo/history.html and branching links, 4/3/05

separate publicly traded companies that would better serve their customers' needs. In February 1996 AT&T began its spin-off of its Systems and Technology business as Lucent Technologies, by giving it the Lucent name. The initial public offering took place in April that year, with the spin-off completion in September, when AT&T distributed its shares in Lucent to the AT&T shareholder community. Director Henry Schacht was chosen to head Lucent, whose IPO raised $3 billion (by 1998 Lucent's market value surpassed that of its parent company AT&T). According to the Lucent website, at its launch, Lucent was a major player in mobility, optical, data and voice networking technologies; Web-based enterprise solutions that link public and private networks; communications software; professional network design and consulting services; and communications semiconductors and optoelectronics. Although Lucent was looking to exploit the inherent advantage of owning such a world renowned research and development facility such as Bell Labs, the quick shifting nature of the telecom business with its fast pace technology innovation rate often forced Lucent to acquire companies in an effort to augment its in-house capabilities and enable better penetration of new markets. Consequently, between 1996 and 2001 Lucent made 38 acquisitions for a grand total of more than $46 billion, including the $24 billion purchase of Ascend Communications in 1999, which made Lucent the leading provider of data networking equipment for service providers (ISPs). Analysts suggest (according to Hoovers) this move was a part of an ongoing assault on Cisco in the networking business. It is important to note that at the time (1999), Lucent seemed very well positioned to lead the telecom market into the 21st century. As many analysts noted, growth rates were projected to be (compound rates through 2003) 30 percent in wireless infrastructure, 15 percent in telecom equipment, and almost 50 percent in optical networking equipment[67], with Lucent

---

Hoover's: http://premium.hoovers.com/subscribe/co/history.xhtml?ID=46656 , 4/3/05

[67] Standard & Poor's, Industry Surveys, "Communications Equipment", VOLUME 167,

accounting for approximately 110 million lines in the U.S., which equals about 58 percent of the local access installed base, as well as 13 percent the worldwide installed base.

Meanwhile, as Lucent was seeking to expand the range of offered services and solutions, the different market segments it was facing were demanding more specialized skills and individual attention. In particular, telecom deregulation ushered new entrants into the telecom arena, including cable television and local as well as long-distance carriers. This meant Lucent's customers became increasingly sensitive, requiring an ever faster order fulfillment rate, greater product availability and the latest technology to provide them with a competitive edge. This led to complementing strategic moves, motivated by management's belief that decentralized structure and decision making would better enable Lucent to serve it's customers, to break Lucent's three operating division into eleven almost independent businesses, and later spin-off some of Lucent's business units as separate companies that would be better equipped to concentrate on specific market segments and their needs. For example, Lucent spun-off its Enterprise Networking Group on September 30th, 2000, as Avaya Inc[68,69]., distributing its shares in the new company to its shareholders. On April 2nd, 2001, Lucent has done the same with its microelectronics business, as Agere Systems[70]. Other factors contributing to Lucent's decisions to sell some of its businesses and restructure included the general 2001 telecommunications industry downturn, which meant lower spending by service providers, both wireless and wireline. This downturn, known also as the bursting of the telecom bubble drove Lucent to identify the market segments with the best growth potential and concentrate on those. This has

---

NO. 51, SECTION 1, December 23, 1999

[68] http://premium.hoovers.com/subscribe/co/factsheet.xhtml?ID=101196, 4/4/2005
[69] http://www.avaya.com/gcm/master-usa/en-us/corporate/whoisavaya/ourheritage/our_heritage.htm, 4/4/2005
[70] http://premium.hoovers.com/subscribe/co/factsheet.xhtml?ID=102887, 4/4/2005

led to the formation of the three business units currently forming Lucent: Integrated Network Solutions, Mobility Solutions and Lucent Worldwide Services. Working with these business units as a core structure has enabled Lucent to report its first profitable (since FY 2000) year in 2004. In addition, Lucent's plan included writing off inventory, consolidating facilities, and shifting production to contract manufacturers, measures which will be elaborated on later.

The year 2000 had been especially tough for Lucent. By the end of FY 2000, Lucent managed to reduce its employee base by about 39,000 employees through layoffs, divestitures, and early retirement. By acquiring Ortel and Chromatis, Lucent was looking to strengthen its position in the optical equipment scene. However, as Lucent was late to enter this market segment (lagging behind on the 10Gigabit OC-192 optical system although it had the technology, selling 2.5Gigabit OC-48 instead, while Nortel was selling the newer systems), this did not yield the desired results and the company reported disappointing FY 2000 earnings. In addition, unpaid bills by clients who went bankrupt (mostly small start-up carriers, as elaborated on in 3.1 – History of the telecommunications industry) had left the company in massive debt. To top it all, Lucent disclosed a revenue recognition problem, and was charged by the SEC (Securities and Exchange Commission) with fraud related to overstatement of sales and income of nearly half a billion dollars. This contributed greatly to Lucent's board's decision to let go of Lucent's CEO Rich McGinn and nominating Henry Schacht as the interim CEO. This of course reflected very badly on the company's stock performance. The Schacht/McGinn saga is elaborated on in great length by Lisa Endlich[71]. The fallout from the 2000 accounting charges was still an issue in 2004, when several past and present Lucent employees were charged by the SEC with securities fraud.

In addition to the financial and legal hardships Lucent was going through, the year 2000 marked a peak in inventory buildup for Lucent, due to the very high rate of innovation, impossible-to-predict customer demands, and financial behavior patterns that were coupled with very optimistic forecasts. All of these factors, while contributing to the buildup of the ever-growing pile of inventory, were also threatening to make these product stocks obsolete very quickly, as newer products were introduced at an amazing rate. This resulted in 4Q2000 results of $6.4 billion in inventory vs. $5.84 billion in sales[72], and a loss of $1.02 billion, compared to a profit of $1.08 billion a year earlier, same quarter.

In 2002, Patricia Russo, formerly COO of Eastman Kodak and a Lucent executive, was nominated CEO for Lucent; while Schacht maintained the role of chairman. In 2003, Schacht was replaced as chairman by Russo and remained on the board of directors.

[71] Endlich, L., *Optical Illusions: lucent and the Crash of Telecom*, Simon & Schuster, 2004

[72] 2Q2001 balance sheet

8 Lucent Supply Chain Strategy – pre 2001[73]

Lucent's supply chain strategy and configuration has undergone a major change following the bursting of the telecom bubble in 2000/2001. It is therefore necessary to describe Lucent's views and consequent strategy in the years before 2001, as well as their current actions and configuration.

While Lucent (before it was even named Lucent) was still part of the AT&T operation, they were subject to the conditions enjoyed by AT&T. This meant enjoying government protection through regulation, which allowed AT&T to focus on growth and generate quality innovation at its own pace through Bell Labs. The relationship with Bell Labs had much weight in shaping AT&T strategy. Not only AT&T, but the broader US and world economy and scientific/technology community have come to rely on Bell Labs to provide excellent innovation, that was driven by investing as much time and money in Bell Labs as was necessary. Consequently, Bell Labs grew to be one of the world's leading research institutions, with eleven Nobel laureates among its ranks, as well as national medal of science winners (9 medals), seven national medals of technology and a Draper prize.

[73] The description of Lucent's pre-2001 supply chain and its different units section relies mostly on the work done by Duncan Scholtz in his 2004 MLOG thesis.

However, as deregulation happened and the market began to buzz with new competitors that demanded ever faster innovation and shorter lead times, the preexisting structure and strategy was no longer adequate. At the time, the correct response to that was allowing greater degrees of independence to different parts of Lucent's operation that were serving different market segments with different technologies. However, this greater degree of autonomy and the constant pursuit of customers resulted in the buildup of excess inventories, which became a major financial risk as the telecom and Internet bubbles burst in 2001. By then it was becoming clear the costs structures needed to be brought down, as customers could not be persuaded to buy at the bloated bubble prices the decentralized organization was generating. In addition, although Lucent's eleven-independent-business-units model was designed to support (if not accelerate) cyclical, spiky and very individualistic customer demands, it appeared not to have met those demands. According to data provided by Lucent, by 2000 less than 80 percent of systems were delivered on time to customers, while for components things were looking much worse, with only about 50 percent on-time delivery rates.

By 2001 Lucent was organized around eleven largely autonomous business units. Each of these units had its own supply chain management practices, which were considered to be mostly a support function for the specific business unit. Each of these eleven business units owned its own manufacturing facilities and EMS relationships, and was responsible for doing its own supplier evaluation. This meant each business unit could do its own design, sourcing, sales and marketing, as well as supply chain management. As Lucent's business encompassed several widely different aspects of the telecom market, including but not limited to semiconductors, wireless equipment and optical switching, this decentralized configuration was designed to enable fast and responsive reaction to customer demands. However, one of the results of this

policy was resource proliferation. Examples of this were Lucent's twenty-nine manufacturing facilities (both domestic and abroad), 16 service and repair centers, more than two hundred warehouses, about 1700 carriers which were used for product delivery, and a workforce consisting of more than twenty thousand employees, all of these were major contributors to Lucent's operating budget which exceeded $1.9 Billion.

8.1 The Design Process

As mentioned earlier, the years leading to 2001 were marked by the proliferation of innovation, fueled by varying customer demands that were almost always attempted to be answered by Lucent and its competitors. Lucent for its own part demonstrated this in 1999 with more than 120 new product and technology introductions[74]. The need to satisfy specific customer requirements that were unique to each customer resulted in independent design teams that reported to each business unit. This meant there was little to no standardization and platforming across Lucent's operation, which naturally resulted in proliferation of not only unique products, but also of parts that could have easily been used across different products. An example of this was "…using forty-seven different enclosure designs, each of which had its own tooling investments… looked like they were made by different companies"[75]. However, the added costs generated by such practices were not limited to duplicate design work and learning curves, but also separate information systems and databases and unnecessary complexities in manufacturing, maintenance and service. For some products, especially optical switching products that were often designed and manufactured for specific wavelengths used by only one customer, a shift in

[74] McGinn, R., "Executive Forum: The Race to Build Next-Generation Networks", California Management Review, Vol. 42, No. 2, Winter 2000

demand could turn huge amounts of inventory virtually obsolete in an instant. These huge inventories were of course there in the first place because customers were demanding the wide-range product availability at very short lead times. The financial risk posed by these inventories and the very rapid development cycle times was one of the major contributing factors to the end-of-quarter deals Lucent was willing to offer its customers, as well as an incentive for putting in place ever riskier financing methods for these customers, when other financial institutions were not longer willing to do so.

8.2 Purchasing and Supplier Base

Although every business unit had its own purchasing autonomy, as well as its own supplier evaluation mechanisms, Lucent had a central Global Purchasing Office (GPO) that was in charge of actual buying and attempted to negotiate deals with suppliers through the power of demand aggregation. However, the GPO's potential for generating cost savings and improving overall efficiency across the different business units was not optimally utilized. This sub-optimal performance was partly caused by the nature of the autonomous systems in each business unit. For example, centralized (or at least unified) information and inventory systems were not in place, so information could not be shared between the different business units. In addition, different program teams were actually competing for raw materials. Those raw materials and components that were common across teams had differing Approved Vendor Lists (AVL) for different programs. According to a senior executive involved with the GPO organization, even when the GPO tried to suggest using alternate parts or specific vendors, those suggestions were often ignored by the different program managers, whose goals were to meet innovation and time to market targets.

[75] Quoted in the MIT Affiliates Day report, October 23rd, 2003

As mentioned in the previous section, designers had a carte blanche and could pick parts and suppliers with little or no consideration of in-house inventory or bargaining power with suppliers. This resulted in a huge supplier base, more than 3000 suppliers by the end of 2000. In addition, purchasing power with these vendors was much diluted, with the top 1000 of them accounting for about 40 percent of material spends[76].

8.3 Operations and Manufacturing

Each of the separate business units' supply chain teams' goal was to give manufacturing the required support. As the main driver behind the different business units was being first-to market, manufacturing VPs had tremendous power driving the supply chain management of each business unit.

Although Lucent was historically relying on its own manufacturing capabilities to deliver superior quality, reliability and speed through the use of automation in manufacturing, as well as process control, by the end of the 1990s Lucent was starting to use EMS partners. Initially, these EMS partners were used to better handle spiky demand. However, as time progressed and the 2000-2001 became evermore evident, these EMS partners were used more and more to reduce the risk involved in capital investment in a weakening market. This had led to an increase in relative production volume transferred to EMS partners. From less than 1 percent in 1998, this volume has grown tenfold to almost 10 percent by 1999. This increase was driven mainly by the desire (and conscious effort) to improve cash flow and capital utilization. Nevertheless, as each of the eleven independent business units was responsible for its own outsourcing policies, it

[76] Mejia – MIT Affiliates Day presentation, 2003

resulted in outsourcing distributed between 25 different EMS partners[77]. In an effort to control EMS proliferation, the Chief Manufacturing Office (CMO) was established, which was intended to help in the consolidation and management of outsourcing Lucent-wide, similar to the GPO's role for purchasing.

8.4 The Virtual Manufacturing Strategy

Early in 2000, as rising inventory levels became more of a problem, Lucent's top management began reviewing the company's manufacturing strategy with the intention of better facing financial pressures and market shifts. In previous years the key to success has been very fast rate of innovation and very short time-to-market. The final goal of every business unit was to make the latest products available at the shortest time possible, to grab as large a share as possible of the fast growing telecom market. Even at the time, it was recognized that this did not come without costs. Some inevitable costs were incurred by playing by the rules of the pre-2001 market were incurred because economies of scale and cost effectiveness had to be foregone, as well as some flexibility to changes and inventory control. In addition, as the company focused on one set of goals, other aspects of Lucent's operation that might have been possible to manage better were not, such as resource redundancy and information sharing. However, as the market changed, these costs were becoming more of a risk to the company, and options for mitigating this risk needed to be considered. Out of several possible options, the chosen strategy came out to be the Virtual Manufacturing Strategy. This strategy meant Lucent was to sell most of its 29 manufacturing facilities to the EMS industry, while at the same time outsourcing its manufacturing requirements. However, to keep the testing and integration of large, complex and

[77] Sherman, S., "Lucent's Manufacturing Transformation…An Update on Our Journey…", Lucent Technologies Internal Document, 2002

sensitive systems in-house, Lucent chose to keep a small network of System Integration Centers (SIC's), which were to be globally positioned[78].

This new strategy was announced by CEO Rich McGinn in April 2000[79]. However, as time progressed, economic conditioned worsened, pricing pressure rose and demand dwindled, it became apparent that fixed costs were not being brought down fast enough. This led to Henry Schacht's announcement of Lucent's intent to accelerate the outsourcing efforts in January 2001.

[78] Ibid.
[79] Lucent press release: "Lucent announces change in global manufacturing strategy" April 19,2000

9 Lucent's post-2001 supply chain: Supply Chain Networks

In an effort to turn its operation into a more responsive customer centered one, whereby all activities are driven by supply chain capabilities, aligning all commitments with Lucent's ability to deliver (pull system), Lucent management founded the Supply Chain Networks (SCN) organization within the company. The SCN was an upgrade of the former Supply Chain Operations (SCO) group, decided on in January 2001 (by Henry Schacht) after an executive meeting in which the importance of supply chain issues became clear, along with the fact that most of these issues lied within the operations realm of responsibility (Meyer and Meyer, 2003). In a 2003 MIT Affiliates Day presentation, Jose Mejia summed up these problems:

- Vertical organizational structure with a silo mentality
- Legacy infrastructure not sufficiently flexible or cost effective
- Supply chain product development and costs could be better leveraged across platforms, suppliers, sourcing
- Supply chain IT systems needed to be more integrated and efficient
- Opportunity to improve visibility and understanding of margin and profitability contribution across the enterprise

- Customer and supply chain connection not optimally established

The first order of the day was for the new organization to collect performance metrics about Lucent and benchmark them against the rest of the industry, which yielded bleak results. According to an unnamed interview with a Lucent executive conducted by Scholtz (2004):

> "It took six months to extract and aggregate data and find a common denominator. The news was pretty bleak – median days of supply were seventy-five, we had over one hundred. On inventory turns, the median was twenty, best in class was fifty, and we were at one-and-change; now we're at over seven. Our cash-to-cash cycle was at 200 days whereas the best-in-class were sixty to ninety days and the median was around 100 days. We established the line of demarcation. The net message was that we were spending more than our competitors on our supply chain."

The organization's motivation revolved around four main elements:

1. Customer intimacy – having a single point of contact. By an intimacy with the customer needs, satisfaction can be enhanced and new revenue generated. In addition, the single point of customer contact shall own all supply chain activities related to the specific project and advocate for the customer.

2. Zero-latency – waste elimination. The elimination of unnecessary delays and waste in the system was set as a goal. In addition to speeding up processes, simplification of processes was expected as well.

3. Margin Management – understanding true costs, together with customers, suppliers and internal stakeholders. According to Rob Picone, vice president of supply chain design and optimization, quoted in Scholtz (2004), costing was a structured process for understanding and realizing the full-stream costs of a proposed product, with the goal of generating desired profitability at an anticipated selling price over a period of time.

4. Cultural change management – keeping a watchful eye for elements or activities not aligned with Lucent's strategy and addressing them. This was augmented by an open "on the table" communication culture.

Mirroring these four elements, the cross-company SCN organization was established, and was made of four functional groups: customer facing, manufacturing facing, product facing and full stream (margin modeling). In addition, these four groups needed to function together to allow a free flow of information. An example of this need is given by Scholtz (2004), with the case of expert engagement. As some decisions taken by the SCN organization were best served by engaging an expert team (with expertise depending on the issue at hand), each such decision required the re-definition of the appropriate expert team, the identification of the right experts for the job, the alignment of these experts to work together and proper incentive structure and metrics for the decision. As this process needed to be carried out for every type of decision, it was important that information flows freely and that each potential team member be recognized for his or her set of skills and expertise.

Although this structure was new, it was based on previously existing functions within Lucent. This is due to the fact that Lucent has already worked with EMS providers and outsourced parts of its manufacturing requirements since the 1990s, mainly during times of peaks in demand, as well as for its SMT (surface mount technology) manufacturing, which required heavy capital investment to become economically justifiable. In addition, past component shortages (like the 2000 tantalum capacitor shortage, brought about by the increase in cell phone manufacturing, heavily using these capacitors) has led Lucent to the creation of the Global Control Tower unit in 2000, whose responsibility it was to measure company exposure to potential shortages in components and manage them accordingly.

9.1 SCN Units – Customer Delivery Organization

As customer needs were now driving supply chain decisions on the one hand, while on the other hand sales teams needed to be informed with the details of the supply chain for them to be able to commit accordingly, the Customer Delivery Organization (CDO) was created. As soon as a contract was signed with a customer, the CDO would take ownership (with a small team headed by a general manager, or GM) and would align with and support the sales and service teams assigned to the customer. In addition, the Lucent World Services (LWS) team was also aligned with, ensuring the installation services provided by the group were optimal, delivery commitments met, and customers happy throughout the process. Furthermore, the CDO supported and managed third parties involved with installation such as EMS partners and logistics providers. Inside the CDO's realm of responsibilities was also oversight of the supply chain performance metrics. The CDO's performance however was measured and incentivized according to customer commitments and measurements, as well as according to Lucent's business strategy and objectives. The following graphic of the CDO's responsibilities is from Scholtz (2004):

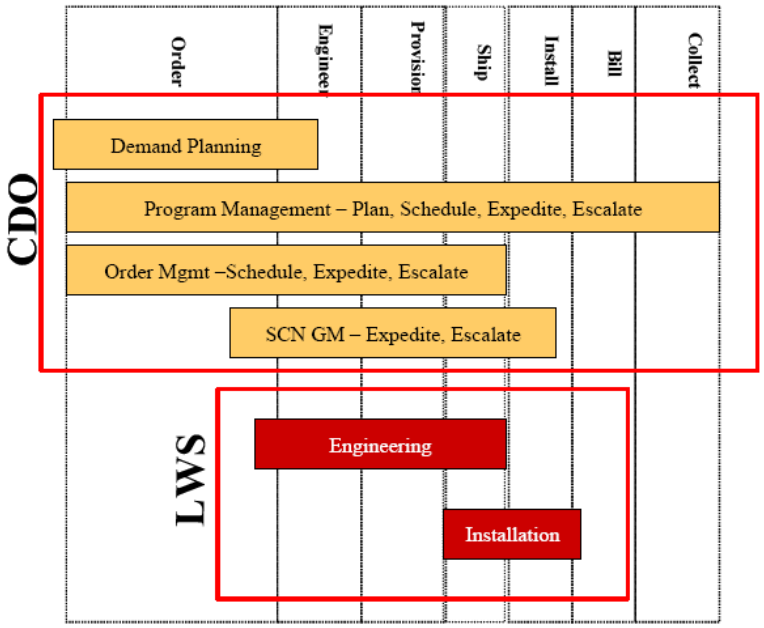


Figure 8 - CDO's Responsibilities

In addition to these changes another major change was the handing over of logistics responsibilities to an outside party – Vastera Inc, a 3PL based in Virginia. The main challenge facing Vastera was the moving of systems from EMS providers or Lucent System Integration Centers (SICs) to customer sites. As Lucent moved to this new operating model with Vastera as its LLP (lead logistics provider), Lucent gave up their network of more than two hundred warehouses and 1,700 carriers. Nevertheless, Lucent still kept an internal team in charge of managing the relationship with this LLP. The LLP's responsibilities were described by Nick De Tura, the VP in charge of the CDO (De Tura, 2003):

- Manage carrier base and transportation processes, including payment and contracting
- Optimize warehouse and distribution network
- Enable delivery information exchange between carriers, customers, suppliers and Lucent CDO to support event management and full chain visibility

- Manage warehousing activities and inventory
- Provide merge-in-transit programs
- Support customer managed inventory initiatives
- Track and manage logistics and deliver metrics to support customer service level agreements (cost, quality and time interval targets)

To manage all these activities, the CDO (that was dispersed throughout the organization, as mentioned earlier) was arranged in a matrix structure, by customer as well as by function.

Whether the customer base was reduced as a result of conscious efforts by Lucent, market conditions reducing overall capital spending or a customer's move to buy from competitors, the fact remains: Lucent faced a reduced customer base (and reduced revenues as well; from $21.3 billion in 2001 to $12.3 billion in 2002 and $8.4 billion in 2003), but nevertheless managed to increase margins by over 230% from 2002 to 2003 (from 13% to 31% according to Lucent's 2003 annual report, and 42% in the 2004 10-K). However, Lucent seized the opportunity to achieve a new level of customer intimacy while focusing on the less-commoditized products it could offer and to create better collaboration (and consequently higher satisfaction) with its customers.

9.2 SCN Units – SCO: SCN's manufacturing facing function

Lucent was moving rapidly towards an outsourcing model, relying evermore heavily on EMS providers, the activities of the CDO, these EMS partners, Lucent's SIC's (by now there were five of those) and other channel partners. The Supply Chain Operations (SCO), headed by Mike Jones, VP of SCO, was in charge of managing all assets and in-inventory, supply chain execution and supply chain evaluation. The CDO was in charge of coordinating and managing manufacturing activities between EMS partners, second tier suppliers and customer installation sites. The operations themselves consisted of these five SIC's that were in charge of integration. In addition, the SIC's were in charge of (Jones, 2003):

- Final assembly of complex products and systems test including software download and system configuration
- Integration, configuration and test, including integration of sub-assemblies, products and original equipment manufacturer (OEM) equipment
- Supplier-facing logistics and order fulfillment
- Coordination of shipments from multiple supply nodes for synchronized system delivery
- New product introduction

- Managing direct fulfillment of customer orders by EMS partners as part of Lucent's virtual manufacturing organization[80]

9.3 SCN Units – Product planning, engineering and supplier management practices

The product planning, engineering and supplier management team's role was to manage component and supplier selection and qualification, as well as the coordination of design processes with the supplier base. This was done through interfacing with the different product design teams. This team was evaluated (and compensated) according to product margins and delivery schedules, as well as on costs. Sourcing strategies were developed by the supplier management teams. These teams were aligned with the design teams as well, and managed the supplier base, outsourcing decisions and relevant business processes. An overarching goal was to reduce the number of suppliers, while creating higher levels of collaboration and partnership with the remaining suppliers. As technologies kept changing and therefore the requirements of the suppliers along with them, annual strategy reviews were conducted to make sure the supplier portfolio was up to date with these requirements. Towards this end, the Supplier Relationships Program (SRP) was established, where suppliers were evaluated and managed, affecting supplier sourcing decisions according to (but not limited to) suppliers contributions to cost savings, generated by involving suppliers in the design phase. The major goals of the program were:

- Joint assessment of opportunities
- Performance measurement, going beyond price

[80] The concept of virtual manufacturing organization is used by Cisco as well, and refers to having products

- Creation of a new forum for idea generation
- A metrics driven process to eliminate marginal suppliers
- Sharing of risks and rewards
- Rewarding of cross-company teams for achievements
- Benchmarking of cost performance with target cost model

This rationalization of suppliers also supported other goals such as a reduction in overall channel inventory, the reduction in component types and the increase of component reuse, as well as management of suppliers supporting Lucent's virtual manufacturing environment directly, dealing with EMS partners through EDI (Electronic Data Interchange), while allowing suppliers visibility into Lucent's order status, forecasting and planning. Towards this end, Lucent collaborated closely with its EMS partners to leverage possible relationships Lucent or its partners had with suppliers, as well as on improving the supplier identification and approval process. These activities are clearly on the borderline between supplier management and the manufacturing facing division, and were enhanced by the skills the EMS partners kept developing, such as design for manufacturability, EDI purchasing systems, etc. Figure 9 - Lucent's Supplier Management Model, is graphic representation of Lucent's supplier management model, as shown in Scholtz (2004):

manufactures by an EMS partner and delivered by that EMS partner directly (or through a 3PL) to the customer, with Lucent (or Cisco) only overseeing the process and not manufacturing or delivering anything themselves.

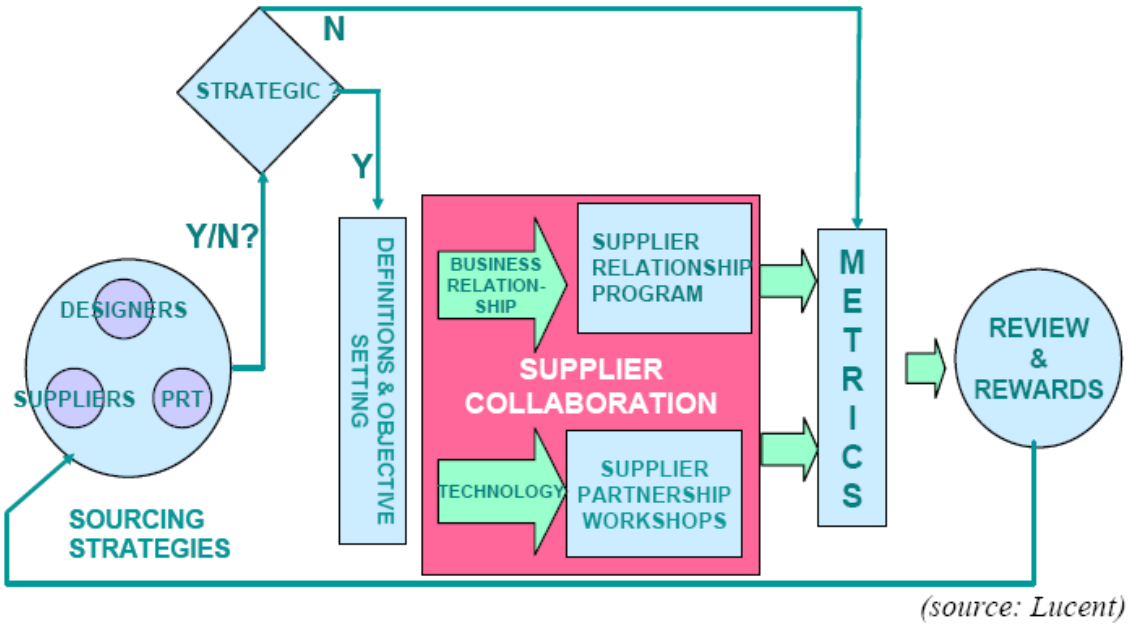


Figure 9 - Lucent's Supplier Management Model

These supplier engagement, evaluation and collaboration measures were enabled by the reduction in parts and suppliers. This was because trying to maintain such relationships (with meetings, close management and supplier involvement with production and design) that are long term and collaborative (instead of just playing suppliers off at each other for price reductions) was both cost prohibitive and organizationally complex (to the point of impossibility) with many suppliers and a very wide array of components purchased. However, as technology changed with time, it was no longer the case where Lucent could just drop one supplier for another who carried and supported the required technology. Suppliers had to be worked with to ensure staying on the forefront (or at least on the desired front) of technology and would be able to support Lucent's changing requirements into the future.

9.4 SCN Units – Margin modeling and target costing

Product profitability for every product (and every customer contract) was done across the enterprise by the SCN organization. Through the use of a top-down cost model, desired margins

were established through an initial definition of price and the treating of remaining costs as the supply chain target. These costs were calculated across all processes, from design to supplier management to manufacturing to delivery. As defined by Rob Picone, VP of supply chain design and optimization (found in Scholtz, 2004), the features and results of this program were:

Features:

- Clear accountabilities for margin across functions
- Actual results tracking and comparisons with the plan
- Clear reporting of major fall-downs in achieving the stated plan
- Rapid reassessment of plan priorities in response to changing business realities.

Results:

- Dramatic acceleration of margin improvement results across the quarters
- Greater predictability of margin results
- Improved visibility to risks, obstacles, and fall-downs in the attainment of margin results
- Longer-term process improvements to assure a sustained high level of performance

9.5 Results Delivered

The SCN's initial purpose was cost reduction, simplification and rationalization. Although much has been said about the impressive results observed in the course of 2001-2004, the initial cost saving results can be best seen in Table 3 - Lucent's SCN Results (Selected

Metrics), provided in Scholtz (2004), along with a couple of pieces of data from Lucent's most recent 10-K form.

Table 3 - Lucent's SCN Results (Selected Metrics)

	Early SCN: 2001	Sept 2002	September 2003
Inventory	$8 Billion (1.3 turns)	$1.4 Billion (5.6 turns)	$632M (7.4 turns) Q4 2003
Gross Margin	12.2% Q1 2002	-14.8%	42.6% Q4 2003
Factories	29 Factories (+10M Sq Ft)	5 Systems Integration Centers (<1M Sq Ft)	5 Systems Integration Centers (<1M Sq Ft)
Manufacturing Budget	$1.9B	$ 435M	< $300M
Circuit Pack Manufacture	90% in High Cost Regions	70% in Low Cost regions	85% in Low Cost Regions
Lucent Repair Centers	16	4	4
Managed Warehouses	500+	101	0 (50+ Logistics Providers)
Supply Base	40% spend with 1000+ suppliers (3000+ suppliers total)	80% spend with 60 key suppliers	80% spend with 60 key suppliers
Delivery Systems Orders	80% in 2001	94%	96% Q4 2003
Delivery Material Only Items	50% in 2001	85%	87% Q4 2003
Customer Loyalty Index	6.78 Q1 2002	6.92	7.38 Q4 2003 (Best in Class 7.43)

(source: Lucent)

In addition to this data, it is worth mentioning that Lucent managed to keep its gross margin at 42% for the fiscal year 2004, while its inventories rose slightly to $822 million in 2004. However, this could be due to accumulation of inventory, as well as to a shift in inventory worth towards current products that have higher worth. In addition, as cost savings have been realized, the SCN's targets are being moved more towards supporting sales teams, enabling better bidding, and price/timeline commitments; or in other words – providing competitive advantage through speed, decision making, resilience and leverage.

10 Summary and Discussion

Both Cisco and Lucent operate within the same industry and are similar in many ways. Both companies are susceptible to similar market forces and dynamics, often cater to the same kind of customers and have access to common resources, such as component providers, contract manufacturers and logistics providers. Nevertheless, there are some differentiating factors as well, including sometimes different products (e.g. routers vs. switches), resulting in an emphasis on different customer segments (e.g. telephony service-providers vs. Internet service-providers). Perhaps one of the most noticeable differences between the two companies is their history and background. Cisco epitomizes the high-tech company founded in the 1980s, growing to its mogul status in the 1990s, drawing upon its innovativeness and lack of history, and allowing it to capitalize on an ability to incorporate a great many start-up companies who share the dot com mentality that was prevalent as the end of the millennium approached. Lucent, on the other hand, has a long and distinguished history, not only imbuing it with a sense of mission, as well as putting at its disposal such impressive resources as Bell Labs, but also sometimes hindering it when drastic changes in its operating model were due. These necessary cultural changes and the difficulties they entail are a recurring theme in comments made by Lucent managers when discussing the transformation process undergone by Lucent that led to the creation of its current supply chain organization.

Both companies present a very similar front on issues concerning supply chain management practices and their strategic importance, as well as on initiatives aimed at

transforming their supply chain operating model to accommodate changes in the market, newly available technologies and best practices (see comparison in Table 4 - Cisco and Lucent Compared). Nevertheless, this might not be so surprising considering the fact that many of the supply-chain-related statements and presentation are given in front of forums whose main interest is supply chains. Although significant amount of data and insight into operations, strategy, mindsets, best practices and obstacles can be gained by going through these corporate-issue materials, these are oftentimes hagiographies that need to be supplemented (and sometimes contrasted) by actual input from the people on the floor, doing the work themselves. In order to better understand what these companies are doing, several questions should be asked, with each question leading to the next. The first of these questions is "What is the business strategy and goals?"

10.1 Cisco's Case

In Cisco's case, the strategic goal is to dominate the networking market with end-to-end networking solutions, while maintaining desired profit margins. The operating model to complement this strategy and enable it was presented in Chapter 5, and its three main elements are software, platform leadership and mergers and acquisitions (along with massive outsourcing, as described in Chapter 6). Looking for the business processes to support these operational elements makes it clear why Cisco chooses to focus on software and communication standards rather than on hardware, with an organization driven by R&D. Complementing this R&D emphasis are however the M&A business processes, which ensure the assimilation of many different innovative technologies and products into Cisco's end-to-end solution offerings. None of these objectives seem to be affected by supply chain practices, which might explain the

emerging picture of the supply chain being used only as a means to cut costs and effectively outsource, and not as a means for achieving sustained competitive advantage.

Looking at all different data sources on Cisco covered in this paper, a picture emerges that is more complex than the images projected through the official presentations. Perhaps the root cause of this is the fact that Cisco is mostly an engineering and marketing company, while supply chain management falls mainly under the Operations rubric. These differences can be seen when looking at the different metrics each of the different functions within Cisco is measured on. While sales and marketing are measured on revenue, the supply chain organization is measured on 1) cost cutting, 2) on-time shipments (sometimes referred to as service level) and 3) reduction in inventory. The most obvious effect of this might be strategic. While strategy should cut across all functions of a company and drive every aspect of what the company is doing, supply chain management does not appear to be the strategic element that is driving Cisco's overall strategy. This causes each Cisco "plant" to have its own supply chain (currently about 5-6 different supply chain structures for different plants), with contract manufacturers (CMs) often treated as transactional partners, with Cisco/CM strategy sessions being more tactic oriented. However, it is not clear that this tactic nature of relations between Cisco and its CM partners is aligned with the fact it takes 18-24 months of lead time to develop required capabilities (on both sides, Cisco's and the CM's). Even when Cisco seeks to review its supply chain strategy with the help of outside partners (like McKinsey), they end up formulating a strategy for a single line of products. True, there might be very good reasons for doing so (such as the different nature of the products, clients, markets and suppliers to name a few). In fact, even within Cisco, lower end products (such as low-end phones and home/small-office products) have shorter lead times than mid-range and high end products, and are typically built to stock

and not build to order. Conversely, customers expect a 10 year support cycle for the mid-range and high end product, something that is not required by the low-end consumers. These different supply chain approaches might impede on Cisco's ability (and perhaps willingness) to come up with and follow a unified supply chain strategy that would cut across all different products, functions and departments. Nevertheless, if different products require different supply chain practices to support their respective operational goals that in turn should complement the overall business strategy, different supply chains for different products may be used. In fact, one of the main reasons not to use several different supply chains is possible economies of scale or synergies that might be achieved through a unified supply chain. As these are business considerations, it might be best not to label one practice as superior to another.

In Lucent's case, historic reasons inhibited it from effectively accommodating change and adapting to it. In Cisco's case, some of the roots of its current supply chain approach might also be traced back to the company's history and the massive blow it managed to survive so well with the burst of the dot com bubble. As much of the pain suffered by Cisco during those hard times was caused by massive amounts of inventory accumulated in the channel, coupled by less-than-satisfactory forecasting, it seems Cisco has learned to treat forecasting figures with caution. These lessons learned would fit well with Cisco's current attempts at shifting to a pull system that would reduce the weight given to demand forecasting. This new pull system would utilize forecasting more for long term material and capacity planning. This view of forecasting requires Cisco to try and optimize its (and its channel partners') inventory levels without putting too much emphasis on forecasting, although Cisco and its forecasting functions recognize the need of inventory optimization.

For a company that has suffered so much due to improper inventory levels not to treat inventory optimization as its top priority might seem strange at first glance. However, when looking at what is driving Cisco's supply chain operations (by looking at metrics for example) one realizes Cisco is focusing on a possible cause for this past massive inventory buildup, namely: inconsistency. Inconsistent product lead times was considered a major issue for Cisco, a problem Cisco considered solved with its current "21 day lead time" policy, which puts a greater emphasis on lead time consistency than on shortening these lead times. In fact, while Cisco might be currently providing customers with products within this 21 day timeframe for 90%-97% of the time (depending on who you ask), they could reduce these lead times considerably (down to a 5 day lead time with 90%-95% service level according to some managers interviewed). However, the resulting added noise in demand is considered more of a problem than the longer lead times. According to one Cisco manager "it's better to be consistent and longer than noisy and shorter".

10.2 Lucent's Case vs. Cisco's Case

Applying the same framework as previously applied to Cisco, in order to better understand Lucent's supply chain practices yields a different picture. In Lucent's case, the overall business strategy seems to be about shaping the telecommunication market while dominating it, which historically was mainly supported by the availability of the Bell Labs resource and its technical prowess. It seems that for (mainly) historic reasons, as well as due to a desire (which is not unreasonable) to rely on and fully utilize the Bell Labs resource, which is very rare and hard to imitate, as well as very valuable, Lucent chose the "In-House" operating model to complement these strategic goals, as opposed to Cisco's outsourcing operating model.

As Lucent chose to perform many of its operations in house (at least until 2001), it realized the strategic importance of supply chain management. However, attention should be given not only to Lucent's specific business processes, but also to its organizational structure and corporate culture. Although these have been blamed for many of the ills that plagued Lucent (and perhaps still do), they have also enabled Lucent to adapt to change through changing its supply chain management practices, albeit too late at times. Still, it seems these changes in supply chain management practices in recent years (as described in Chapter 9) might have brought Lucent's business processes closer to those of Cisco, with massive cost cutting and outsourcing. Nevertheless, as Cisco and Lucent were examined through different lenses (with more inside information from Cisco), the lessons learned from Cisco suggest Lucent's inside might prove to be different than the image projected by the company.

In conclusion, although this phase of the project is termed "looking at excellent supply chains", in Cisco's and Lucent's cases it seems one is actually looking at two great companies, first and foremost. The fact these two firms managed to survive a blow that killed many a great company, and the ensuing changes in supply chain practices each of these firms undertook following those events are a clear indicator for the importance of effective and efficient supply chains, even when not utilized consciously to create competitive advantage.

Table 4 - Cisco and Lucent Compared

Cisco	Lucent (Post-2001)

• Competitive Strategy
  o Dominate networking market (datacom)
  o End-to-end solution provider
• Operating Model
  o Outsourcing physical SC
  o Focus on software vis a vis hardware
  o Platform Leadership
  o M&A for acquiring new technologies
• Operational Performance Objectives
  1. Cutting Costs
  2. On-time shipments
  3. Reducing inventories
• Tailored SC Practices
  o M&A operational protocols
  o Virtual manufacturing
  o Quoting customers (long lead-time to reduce noise)
  o Using Kanbans, shift to pull system
	• Competitive Strategy
	  o Dominate networking market (telecom)
	  o Shape the market
	• Operating Model
	  o Outsourcing manufacturing
	  o In-house technology development
	  o Single point of customer contact
	• Operational Performance Objectives
	  o Reducing process lead times and waste
	  o Reducing inventory waste
	  o Cutting Costs (target cost benchmarking)
	• Tailored SC Practices
	  o Customer Delivery org.
	  o SCO - virtual manufacturing
	  o Supplier collaboration (SRP)
	  o Margin modeling and target costing

Bibliography

Ahlawat, Rachna and Christian Canales Holzeis. "Market Analysis: Ethernet Switch Market Shows Signs of Strong Recovery in 1Q04." Gartner Dataquest, August 4, 2004.

Anderson, David L., Copacino, William C., Lee, Hau L., and C. Edwin Starr. "Creating and Sustaining the High Performance Business: Research and Insights on the Role of Supply Chain Mastery." Accenture research paper, 2003. <http://www.accenture.com/xdoc/en/services/scm/scm_thought_supplychain.pdf>, accessed 9/3/2004.

Berger, Andrew J., and John Gattorna. Supply Chain Cybermastery: Building High Performance Supply Chains of the Future. Aldershot, Hampshire, England; Burlington, VT: Gower, 2001.

Berinato, Scott. "What Went Wrong at Cisco - Case Study: Cisco". Framingham, MA, 2001. Case Study. CIO Magazine. (August 1, 2001): CXO Media Inc. 10/31 2004. <http://www.cio.com/archive/080101/cisco.html>.

Blood, Steve. "Cisco Faces Challenges to Its Lead in IP Telephony". Gartner Inc. Commentary. April 16 2004. <https://web.mit.edu/is/gartner/intraweb/research/120500/120586/120586.html>. Accessed 1/22/2005

Boisellet, Calude. VP Telecom segment, DHL Solutions. January 2005 Interview.

Borg, Scott. "Real-Time Profit Optimization: Coordinating Demand and Supply Chain Management: An Overview." Trans. Tuck School of Business at Dartmouth and Cisco Systems Inc. Thought Leadership Summit on Digital Strategies. Tuck School of Business, Dartmouth: Glassmeyer/McNamee Center for Digital Strategies, Tuck School of Business at Dartmouth and Cisco Systems Inc., 2002.

Bovet, David, Joseph Martha, and Mercer Management Consulting. Value Nets: Breaking the Supply Chain to Unlock Hidden Profits. New York: John Wiley, 2000.

Brock, Eugene. Manufacturing Business Operations Manager, Cisco. May 2005 interview.

Bunnell, David, and Adam Brate. Making the Cisco Connection: The Story Behind the Real Internet Superpower. New York: John Wiley & Sons, 2000.

Burrows, Peter. "Can Cisco Settle for Less That Sizzling?" BusinessWeek February 21, 2005 2005: 62-65.

Carson, J., Vice president, Lucent SCN, MIT affiliates Day presentation, 2003

Cisco Systems, CGE&Y. A Corporate Alliance: Strength in Global Strategy. <http://www.cisco.com/global/NL/news/pdf/CGEY.pdf>. Accessed September 2004.

Cisco Systems, Inc. Cisco Systems, Inc. 2003 10-K form for Fiscal Year Ended July 31, 2004. <http://www.sec.gov/Archives/edgar/data/858877/000119312504158427/d10k.htm>, accessed 10/3/2004

Cohen, Shoshanah, and Joseph Roussel. Strategic Supply Chain Management: The Five Disciplines for Top Performance. New York: McGraw-Hill, 2004.

De Tura, N., Vice president, Lucent SCN CDO, "The SCN Customer Delivery Organization", MIT affiliates Day presentation, 2003.

"e-Business Transformation: Challenges for the Communications Industry." US Interactive Industry Solutions white paper, 2004. <http://www.usinteractive.com/news/analysis/ebusiness_transformation.asp>, accessed 10/5/2004,

Endlich, Lisa. Optical Illusions: Lucent and the Crash of Telecom. New York: Simon & Schuster, 2004.

Fisher, Marshall L. "What Is the Right Supply Chain for Your Product?" Harvard Business Review.March-April (1997).

Gawer, Annabelle, and Michael A. Cusumano. Platform Leadership: How Intel, Microsoft, and Cisco Drive Industry Innovation. Boston, Mass.: Harvard Business School Press, 2002.

Graham-Hackett, Megan. "Computers: Networking." Standard & Poor's Industry Survey. March 13, 2003.

Graham-Hackett, Megan. "Computers: Networking." Standard & Poor's Industry Survey. September 18, 2003.

Grant, Robert M. Contemporary Strategy Analysis: Concepts, Techniques, Applications. 3rd ed. Cambridge, Mass.: Blackwell, 1998.

Hahn, Wm. L. "Forecast: Global Telecommunications Market Take, 3Q04 (Executive Summary)." Gartner Dataquest, October 12, 2004.

Hammer, Michael. "Deep Change." Harvard Business Review.April (2004).

Heinrich, Claus E. Adapt or Die: Transforming Your Supply Chain into an Adaptive Business Network. Hoboken, N.J.: J. Wiley & Sons, 2003.

Hoover's Inc. "Hoover's Online Report Builder: Cisco Systems, Inc." Hoover's, Inc., 2005.

Hoover's Inc. "Hoover's Online Report Builder: Lucent Technologies, Inc." Hoover's, Inc., 2005.

Hoyt, David. "Lucent Technologies: Global Supply Chain Management - a Case Study." Ed. Hau Lee. Stanford, CA: Stanford University Graduate School of Business, 2001.

Hoyt, David and Lopez-Tello, Enrique. "Lucent Technologies: Positioning and Postponement - a Case Study." Stanford, CA: Stanford University Graduate School of Business, 2001. Ed. Hau Lee.

Huffington, Arianna, <http://www.ariannaonline.com/outsourcing/index.php>

Jones, Caroline. "Teleworking: The Quiet Revolution." Gartner Inc., September 17 2004. <https://web.mit.edu/is/gartner/intraweb/research/122200/122284/122284.html>, accessed 1/22/2005.

Jones, M., Vice president, Lucent SCN SCO, MIT affiliates Day presentation, 2003

Jopling, Elroy, Carr, Charles R., Koppman, Steve and Unden, Lisa. "Predicts 2005: Communications Services Are Changing." Gartner Inc., November 1, 2004. <https://web.mit.edu/is/gartner/intraweb/research/123800/123887/123887.html>, accessed 1/22/2005

Kalakota, Ravi and Marcia Robinson. E-Business: Roadmap for Success. Addison-Wesley Information Technology Series. Reading, Mass.: Addison-Wesley, 1999.

Kamman, Steve and Andrew Wang. "Core Router Market remains weak." CIBC World Markets Equity Research. November 14, 2002.

Koch, Christopher. "The ABC's of Supply Chain Management". Framingham, MA, 2002. CIO Magazine. (1/22/2002): CXO Media Inc. 9/2 2004. <http://www.cio.com/research/scm/edit/012202_scm.html>.

Kull, Frank. Business Operations Director, Cisco. May 2005 interview.

Lange, Richard de. Key account manager, TNT Divisional Head Office Logistics (TPG), January 2005 interview.

Lewinski, Hans-Georg von. Leading partner, Accenture Supply Chain Management Service Line, UK. January 2005 interview.

Long, David W. De. "Cisco Systems: An Integrated Approach to Supporting Knowledge Workers." Art of Work - an Accenture publication 7/13/2001 2001.

Lucent Technologies Inc. Lucent Technologies Inc. 2003 10-K form. <http://www.sec.gov/Archives/edgar/data/1006240/000120677403000885/d13595k.htm>, accessed 10/3/2004

Lucent Technologies Inc. Lucent Technologies Inc. 2004 10-K form. <http://ccbn.tenkwizard.com/filing.php?repo=tenk&ipage=3128206&doc=1&total=&attach=ON&TK=LU&CK=1006240&FG=0&CK2=1006240&FC=000000&BK=FFFFFF&SC=ON&TC1=FFFFFF&TC2=FFFFFF&LK=000080&AL=FF0000&VL=000080>

Marek Fernandez, Megan. "IP Telephony Adoption Poised to Dominate North American Market." Gartner Dataquest Research Brief, August 24, 2004.

McCool, John. VP Gigabit Systems Business Unit, Cisco. May 2005 interview.

McCombs, Mathew. Production Operations Manager, Cisco. May 2005 interview.

Metz, Erwin. Key account director High-Tech, TNT Corporate Logistics (TPG). January 2005 Interview.

Meyer A., Meyer, D., "MIT Affiliates Day at Lucent Technologies: Evolving the Supply Chain Organization of the Future", MIT Center for Transportation and Logistics, November 12, 2003

Miller, Jim. VP Manufacturing Operations, Cisco. January 2005 interview.

Miller, Jim. VP Manufacturing Operations, Cisco. February 2005 interview.

Miller, Jim. VP Manufacturing Operations, Cisco. May 2005 interview.

Morgan Stanley. "Industry Overview: Highlights of Tech Sector Reports." Morgan Stanley, March 8, 2002.

Neal, Douglas. Research Fellow, CSC Research Services. January 2005 interview.

Notter, George C. and Cobb Sadler. "A switch to packet: The transition from circuit." Deutche Bank Equity Research Industry Update. Deutche Bank, October 2, 2003.

Pallatto, John. "Charles Giancarlo, in Charge of 4 New Technology Groups at Cisco Systems, Discusses Goals of the Firm's Latest Reorganization." Internet World 7.18 (2001): 30+.

Paulson, Ed. Inside Cisco: The Real Story of Sustained M & A Growth. New York: Wiley, 2001.

Peterson, Rachel. Demand Planning Manager, Cisco. May 2005 interview.

Picone, R., Vice president, Lucent SCN, MIT affiliates Day presentation, 2003.

Poirier, Charles C. The Supply Chain Manager's Problem-Solver: Maximizing the Value of Collaboration and Technology. Boca Raton, Fla.: St. Lucie Press, 2003.

Poirier, Charles C. Using Models to Improve the Supply Chain. Boca Raton, Fla.: St. Lucie Press, 2004.

Pond, Randy. "Evolving Manufacturing for Productivity and Growth, SCOR 2005 Executive Retreat Presentation." Ed. Yishai Boasson, 2005.

Pond, Randy. SVP Processes and operations, Cisco. 2005 interview.

Porter, Michael E. "What Is Strategy?" Harvard Business Review. November-December (1996).

"Proceedings of the Supply Chain 2020 Project's European Advisory Council Kickoff Meeting". Madrid, Spain, 2004. MIT. 9/8 2004. <http://web.mit.edu/ctl/www/research/sc2020/SC2020%20EAC%20Kickoff%20Proceedings.pdf>.

"Proceedings of the Supply Chain 2020 Project's European Advisory Council Q3 2004 Meeting". Webcast, 2004. MIT. 9/15 2004. <http://web.mit.edu/ctl/www/research/sc2020/SC2020%20Q4%202004%20IAC%20Proceedings.pdf>.

"Proceedings of the Supply Chain 2020 Project's European Advisory Council Q4 2004 Meeting". Austin, TX, 2004. MIT. 12/9 2004. <http://web.mit.edu/ctl/www/research/sc2020/SC2020%204Q04%20IACProceedings.pdf>.

"Proceedings of the Supply Chain 2020 Project's Industry Advisory Council (IAC) Kickoff Meeting". Cambridge, MA, 2004. MIT. 5/24 2004. <http://web.mit.edu/ctl/www/research/sc2020/SC2020%20IAC%20Proceedings.pdf>.

Richardson, Susan. "Telecom and TV Convergence Become a Triple-Play Reality." Gartner Inc., October 4, 2004. <https://web.mit.edu/is/gartner/intraweb/research/123600/123608/123608.html>, accessed 1/22/2005.

Schadler, Ted, "Laptops and Home Networks Transform Behavior", research document, Forrester Research, May 27th 2005

Scholtz, Duncan M. L. "Lucent SCN: Leveraging the Fully Integrated Supply Chain." Master of Engineering in Logistics Thesis. Massachusetts Institute of Technology, 2004.

Shah, Alkesh, Bilotti, Richard and Simon Flannery. "Wireline Networking Equipment: Voice-over-IP Conference Highlights." Morgan Stanley, May 20, 2004.

Shah, Alkesh and Angela Dean. "Wireline Networking Equipment: Morgan Stanley Global Communicator - June 04." Morgan Stanley, June 29, 2004.

Shankar, Bhawani, Desai, Kobita and Sumit Malik. "Telecommunications Network Outsourcing Has Promise and Risk." Gartner Inc., September 7 2004. <https://web.mit.edu/is/gartner/intraweb/research/122300/122380/122380.html>, accessed 1/22/2005.

Tay, Ee Learn. "A Real Options Approach to Manage Flexible Contracts in the Telecommunication Networking Industry." Master of Engineering in Logistics Thesis. Massachusetts Institute of Technology, 2004.

"The Information Edge". 2000. Online Article. Outlook Special Edition - an Accenture publication. (9/3/2004): Accenture. 9/3 2004. <http://www.accenture.com/xd/xd.asp?it=enweb&xd=ideas%5Coutlook%5Cspecial2000_2%5Cse2_contents.xml>.

"The New Telephony: VoIP Turning Telecommunications Business inside Out". 2005. CNN.com. (4/14/2005): Associated Press. 4/14 2005. <http://www.cnn.com/2005/TECH/Internet/04/13/new.telephony.ap/index.html>.

Vogelstein, Fred. "The Cisco Kid Rides Again." Tech Special Cover Stories. Fortune July 26, 2004.

Waters, John K. John Chambers and the Cisco Way: Navigating through Volatility. New York: Wiley, 2002.

William C. Copacino, Roger W. Dik. "Why B2B E-Markets Are Here to Stay". 2001. Outlook - an Accenture publication. November 2: Accenture, 2004.

"Worldwide Switching, Routing Market Shows Upswing". 2004. Industry Overview. Lightwave. (1/2004): PennWell. 10/8 2004. <http://lw.pennnet.com/Articles/Article_Display.cfm?Section=ARTCL&ARTICLE_ID=196044&VERSION_NUM=1>.

< http://www.webopedia.com/TERM/r/router.html>