INTER-COMPANY COLLABORATION WITHIN A LARGE LEAN SUPPLY CHAIN INITIATIVE

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Submitted to the MIT Sloan School of Management and the Department of Civil & Environmental Engineering in Partial Fulfillment of the Requirements for the Degrees of

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ABSTRACT

Cisco and its four contract manufacturing partners are collaborating to implement a lean replenishment methodology across their supply chain. The new system is expected to result in minimized inventory exposure, increased supply chain flexibility, and improved speed to customer. Implementation of such a large standardized initiative requires close collaboration within and between multiple companies which makes it even more complex. Understanding the current state of collaboration within such a large initiative will enable improvements for future inter-company initiatives. This work analyses how Cisco and Flextronics collaborate within this large joint initiative. The analysis utilizes a combination of process mapping and known frameworks for organizational and cross company collaboration analysis. In addition, a dynamic supply chain simulation addressing a particular concern within the initiative is provided. Based on this characterization recommendations for how Cisco and Flextronics can improve collaboration for future joint initiatives are made.

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BIOGRAPHICAL NOTE

Maria Ritums Mentzer was born on November 25th, 1975 in Stockholm, Sweden. She studied Civil Engineering at the University of South Florida in Tampa and received a BS degree in August of 2000. Upon graduation she immediately continued her studies in Materials Science and Engineering at North Carolina State University. She successfully defended her MS thesis titled "Iron and Chromium Doping of Gallium Nitride for Development of Dilute Magnetic Semiconductors" and received a MS degree in December of 2002. After graduation Maria worked for one year as a Civil Engineering Analyst with Kimley-Horn and Associates in Sarasota, FL. After which she took a position with Intel Corporation in Colorado Springs, CO. At Intel Maria held positions as Lithography Process Engineer and later as Lithography Maintenance Manager. In 2007 Maria was somehow accepted into Massachusetts Institute of Technology's Leaders for Manufacturing program. Upon graduation from MIT Maria will move to Folsom, CA to continue her career with Intel Corporation as part of Intel's Supply Planning Organization.

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1 Introduction

Cisco and Flextronics collaborate in a variety of ways. Cisco currently outsources manufacturing of their products to four major contract manufacturers, one of which is Flextronics. Flextronics manufactures Cisco's most complex configure-to-order products. Managing production, operation, as well as supply chain planning and execution for these products requires a close and productive partnership between the two firms. On a tactical level, employees from each company collaborate to conduct everyday business tasks and processes. For example, order data is transmitted between the companies ERP systems through network-enabled systems, production reports, forecasts, and scorecards are reviewed and decisions are made in recurring daily, weekly, and monthly meetings. Information flows back and forth between the companies to enable engineering changes to be transmitted and implemented. Collaboration also occurs on a more strategic level where employees and teams from each company collaborate in joint projects or processes to achieve longer term goals. For example, Cisco sends new employees to Flextronics Austin, TX plant for three weeks training to learn and experience how their products are manufactured. Another example is the Lean 2.0 effort where Cisco and its manufacturing partners are working in joint teams to design and implement supply chain improvements.

The objective of this work is to study and propose improvements to how Cisco and Flextronics collaborate to address continuity issues of shared processes. In order to propose appropriate improvements, a characterization of the current state of collaboration between the two firms is performed identifying collaboration gaps and opportunities for improvement. The study focuses on Cisco and Flextronics supply chain organizations and more specifically Cisco's Lean 2.0 Demand Pull Initiative, a major multi-company collaborative supply chain improvement initiative. From concept and design to implementation this initiative represents a multi-year long collaborative effort between Cisco and Cisco's four major contact manufacturers (CMs): Celestica, Flextronics, Foxconn, and Jabil. The current state characterization of Cisco and Flextronics collaboration is performed by using a combination of end-to-end order fulfillment process mapping, interviews, direct observation, and application of existing frameworks from literature. Finally, a dynamic supply chain simulation is presented to address a specific collaborative pain point within the Lean 2.0 Demand Pull initiative.

Although this study focuses specifically on collaboration between just Cisco and Flextronics, it is the author's hope that the observations, findings, and recommendations will provide valuable information and lead to improved future inter-company collaborative efforts for all stakeholders within the joint initiative as well as add knowledge to other companies beyond this initiative.

1.1 Statement of Problem

> *"It's the companies that figure out how to drive integration and collaboration with supplier partners and with the supply chain and engineering teams, all at once, and make it truly a joint development team, that are able to launch innovative products quickly"*
>
> - Prentis Wilson, Vice President of Product Operations at Cisco Systems, in an August 2008 article[1]

According to a 2006 Supply Chain Directions Summit survey, 92% of Fortune 500 manufacturers and retailers stated that improving collaboration would help address their supply chain issues.[2] Cisco and Flextronics have already collaborated to address many of their supply chain issues and drastically reduced their inventory turns and delivery performance. But with a goal of becoming the number one supply-chain company in the world, Cisco constantly pursues continued improvements of their supply chain.[3] With implementation of Cisco's Lean 2.0 initiative Cisco expects further supply-chain improvements such as increased speed to customer, improved supply-chain flexibility, and reduced inventory costs. Perhaps most importantly, the new supply chain system is expected to establish a joint standard between Cisco's and its manufacturing partners upon which to base future improvement efforts. In order to establish this standard it is not enough to focus only on systems and processes, it is also essential that Cisco

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[1] Murphy, J. W. (2008), *What a bright idea: Innovation stems from convergence of design, supply chain excellence,* www.supplychainbrain.com/content/headline-news/single-article/article/what-a-bright-idea-innovation-stems-from-convergence-of-design-supply-chain-excellence/ August 14, 2008

[2] Mendez. A. (2006), *Using Collaboration to improve supply chain value,* http://www.cisco.com/en/US/solutions/collateral/ns340/ns856/ns870/Building_on_Experience.pdf

[3] Murphy, J. V. (2008), *Collaboration helps Cisco Systems fight growing complexity,* http://www.supplychainbrain.com/content/nc/industry-verticals/high-techelectronics/single-article-page/article/collaboration-helps-cisco-systems-fight-growing-complexity/, April 24, 2008

and Flextronics establish a collaboration standard and processes to allow improvements to be made in how the companies work together to reach new joint goals. By improving inter-company collaboration Cisco and Flextronics will be able to more effectively drive innovation and execution of future joint initiatives. An effective improvement effort requires understanding of the current state and then addresses the gaps between current and ideal state. In order to understand the current state one has to undergo some sort of measurement and data gathering. During my time at Cisco and Flextronics I did not come across any systematic attempt to measure the extent of their current collaboration. Hence this study attempts to characterize current Cisco and Flextronics collaboration and highlight collaboration gaps to provide a baseline for future improvements in Cisco and Flextronics inter-company collaboration.

1.2 Thesis Organization

This thesis is organized into eight chapters. An introduction and problem statement are presented in chapter one, after which chapter two gives brief company overviews of Cisco and Flextronics. Chapter three reviews literature providing information, frameworks, and ideas around inter- and intra-company collaboration used in this work. The remaining chapters offer observations, analysis, and characterization of Cisco and Flextronics collaboration, with a particular focus on collaboration within Cisco's Lean 2.0 Demand Pull initiative. Each chapter provides recommendations based on particular characterization approaches or tools used. Chapter four offers recommendations based on an Order Fulfillment Process Map analysis performed in order to find inter-company collaboration touch and pain points. Chapter five provides a background of Cisco's Lean 2.0 Demand Pull Initiative and then examines inter-company collaboration within this initiative using the Three Lens Analysis framework[4]. Chapter six continues the analysis of collaboration within the Lean 2.0 Demand Pull Initiative by using a survey developed by Hansen and Nohria [5] to identify collaboration barriers within the initiative. Chapter seven describes simulation work done to address a particular collaboration pain point and implementation barrier in the Lean 2.0 Demand Pull Initiative. Finally, chapter eight provides a summary of the findings and recommendations made and finalizes with a conclusion.

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[4] Carrol, J. S. (2006), *Introduction to Organizational Analysis: The Three Lenses,* MIT Sloan School, Revised June 2006

[5] Hansen, M. T., Nohria, N. (2004), *How to build collaborative advantage,* MIT Sloan Management review, Fall 2004

2 Company Overview

2.1 Cisco Systems, Inc.

Cisco develops Internet Protocol (IP) based networking technologies and sells industry leading products and solutions in the company's core development areas of routing and switching. Cisco has grown to become a large, global company with over 67,000 employees and is the largest provider of internet technologies in the world.[6] Headquartered in San Jose, CA, Cisco was founded in 1982, incorporated in 1984, and made public in 1990. Cisco's Fiscal year 2008 revenue was $39.5 Billion, resulting in a net income of $8.1 Billion. Growth has been achieved largely through acquisitions. Cisco designs and sells its products, such as routers, switches, and phones, in four customer segments; commercial, service provider, enterprise, and consumer. In the lower-end consumer space Cisco's Linksys brand produces routers and other products that consumers buy at retail stores and use in their home or small business to power their Local Area Network (LAN) or other entertainment and home networking products. On the high-end side of the spectrum, Cisco's service provider division sells to large and mid-sized telecommunications and cable companies around the world. These companies need highly specialized, very complex and very expensive products. In the middle Cisco provides switching and routing technologies that allow enterprises and small businesses to power the internet. These mid-end products are the segment that "really made the company".[6] With the exception of the products sold through retail channels, the majority of Cisco's products are configured to order; where the customer specifies the components they want. These products can have a very high level of complexity and have product life cycles that vary from extremely short to quite long. [6] Cisco designs their products in-house but 100% of the manufacturing is outsourced to contract manufacturers (CMs) around the globe. Cisco's major contract manufacturing partners are Celestica, Flextronics, Foxconn, and Jabil. Cisco also uses Quanta, HP, and IBM for specific Software solutions. Cisco also partners with a variety of warehousing and transportation partners such as Menlo, Schenker, UPS, Expeditors International, and Fed Ex. Cisco offers their very wide range of products around the

[6] Murphy, J. V. (2008), *Collaboration helps Cisco Systems fight growing complexity*, http://www.supplychainbrain.com/content/nc/industry-verticals/high-techelectronics/single-article-page/article/collaboration-helps-cisco-systems-fight-growing-complexity/, April 24, 2008

world through multiple segments and channels. In many parts of the world Cisco accesses the market through partners; selling through value-added resellers and distributors as well as having direct sales to corporations and to service providers and enterprises. Instead of using a divisional structure to manage its complex, global, configure-to-order supply chain, Cisco uses a centralized supply chain organization consisting of approximately 2,000 employees. This global organization is responsibility for global supplier management, manufacturing and product operations, advanced sourcing, reverse logistics, manufacturing technology, quality, demand management, and planning for all products.[7]

2.2 Flextronics International

Singapore based Flextronics International is a leading global provider of contract manufacturing services or EMS (Electronics Manufacturing Services) to a wide array of customers. Flextronics delivers complete design, engineering and manufacturing services as well as integrated supply chain services to Original Equipment Manufacturers (OEMs). Flextronics participates in the automotive, mobile, computing, consumer digital, infrastructure, industrial, auto, and medical market segments. Flextronics have manufactured and in some cases designed a wide array of popular products for their customers including Sony Ericson and Motorola cell phones, Microsoft Xbox game consoles, Hewlett Packard inkjet printers, Xerox desktop copiers, Nortel communication equipment, Cisco high-end routers, and even Lego pieces.[8] Founded and incorporated in 1990 and made public in 1994, Flextronics has grown mostly thorough acquisition. In October of 2007 they acquired the then third largest player in the EMS industry, Solectron, Inc. This acquisition solidified Flextronics spot as the second largest player in the EMS industry with three times the revenue of the next largest competitor. The EMS industry leader is Taiwan-based Hon Hai Precision Industry Co. (Ltd.), commonly known as Foxconn.[9] With 162,000 employees worldwide Flextronics had fiscal year 2008 revenue of $27.6 Billion.

[7] Murphy, J. V. (2008), *Collaboration helps Cisco Systems fight growing complexity*, http://www.supplychainbrain.com/content/nc/industry-verticals/high-techelectronics/single-article-page/article/collaboration-helps-cisco-systems-fight-growing-complexity/, April 24, 2008

[8] Ferry, J. (2004), *Flextronics: Staying Real in a Virtual World*, Strategy+Business Magazine issue 37, winter 2004

[9] Folgo, E. J. (2008), *Accelerating Time-to-Market in the Global Electronics Industry*, SM Thesis, Massachusetts Institute of Technology, June 2008

As is common in the EMS industry, Flextronics operates on thin margins, and in 2008 Flextronics had a net loss of $0.6 Billion. In 2006 Flextronics reorganized from a geographical region-based organizational structure to a market segment and product line focused structure. In the new matrix organization business units are ran as P&L centers and supported by and integrated through centralized functions such as finance, IT, human resources, materials, operations, etc. In the new structure Flextronics organizes their teams around customer accounts, providing customers with one interface worldwide instead of different representatives for each geographical region. Flextronics' advantage is achieved by controlling the production process and building close relationships with its customers. Flextronics takes advantage of its global manufacturing footprint to sell services in different regional markets, and it organizes according to skill sets that are deployed at the regional facilities. They site higher-technology service in higher-cost and higher-skill regions, and back-end manufacturing in lower-cost regions.[10]

[10] Bitran, G. R., Gurumurthi, S. and Lin Sam, S. (2007), *The need for Third-Party Coordination in Supply Chain Governance,* MIT Sloan Management review, Spring 2007

3 Literature Review

This chapter reviews literature that provides useful frameworks and tools for characterizing current collaboration as well as information and ideas for how collaboration can be improved.

3.1 Barriers to Collaboration

BusinessDictionary.com defines collaboration as a "cooperative arrangement in which two or more parties (which may or may not have a previous relationship) work jointly towards a common goal".[11] Traditionally collaboration has been a way for organizations and teams within a company to enhance company performance. Hence, literature on intra-company collaboration is fairly abundant. Hansen and Nohria provide a nice description of the importance of collaboration within firms and how to overcome collaboration barriers. In their view collaboration is the reason for firms' existence: "... firms come into being in order to enable human beings to achieve collaboratively what they could not achieve alone. If one accepts this as the true purpose of any organization, then the main focus of executive's attention should be on how to foster collaboration within their companies." [12] They claim that it will become increasingly difficult for multinational corporations to compete based on economies of scale and scope as the world's goods, labor and capital markets become more efficient. Instead, competition will be based on how well the corporation is able to stimulate and support inter-unit collaboration to take advantage of globally dispersed resources. Furthermore, they argue that since collaboration does not come automatically it can become a source of competitive advantage. They forecast that the ability to share knowledge within the company and stimulate collaboration between business units, subsidiaries, and functional departments will become increasingly important and eventually replace traditional economies of scope such as effective utilization of physical assets and brand exploitation. Hansen and Nohria also provide a nice framework linking value created through collaboration, barriers to inter-unit collaboration, and managerial actions that can reduce those barriers and improve value creation (see tables 1, 2, and 3). Hansen and Nohria also provide a survey to help identify company specific barriers and based on the survey results

[11] BusinessDictionary.com, http://www.businessdictionary.com/definition/collaboration.html, 25 February 2009

[12] Hansen, M. T., Nohria, N. (2004), *How to build collaborative advantage,* MIT Sloan Management review, Fall 2004

suggest appropriate managerial levers to reduce the barriers. A modified version of this survey was used in this research to help characterize collaboration between Cisco and Flextronics (see chapter 5 for more details on the survey).

Value Created	Details
Cost savings	Through the transfer of best practices
Better decision making	Resulting from advice obtained from colleagues in other subsidiaries
Increased revenue	Through the sharing of expertise and products among subsidiaries
Innovation	Through the combination and cross-pollination of ideas
Enhanced capacity	Through collective action that involves dispersed units

Table 1: Value creation through collaboration (Hansen and Nohria)

Collaboration Barrier	Potential Causes
Unwillingness to seek input and learn from others	<u>Not-invented-here problem</u> o In-group bias leading to the overvaluing your own group and undervaluing other groups o Expectation and pressure for people to fix their own problems o Reward systems may give more credit for heroic individual effort than collaborative effort o Belief that others have nothing to teach o Belief that your problems or situation is unique
Inability to seek and find expertise	<u>Needle-in-a-haystack problem</u> o Costs of searching outweigh the benefits o Lack of connections or connectors between people who need information and people who have information o Lack of, or difficult to access, databases, knowledge management systems, and electronic search engines
Unwillingness to help	<u>Hoarding-of-expertise problem</u> o Competition between units o Performance management incentives focusing on individual performance o Lack of incentives to foster cooperation and shared identity among employees
Inability to work together and transfer knowledge	<u>"Stranger" problem</u> o Knowledge is tacit or specific to a context or culture and requires people to already have relationships in order to understand each other o Lack of professional relationship or common communication frame in which each party understands how the other uses subtle phrases or explains difficult concepts o Difficult to articulate, understand, and absorb complex technologies

Table 2: Barriers to Collaboration (Hansen and Nohria)

Management Levers	Details
Leadership behaviors	o Leaders can motivate people to seek and provide help by signaling the importance of collaboration by working together among themselves
Shared values and goals	o Create and articulate shared values related to teamwork o Develop and articulate unifying goals - powerful goals that stop myopic unit-focused behaviors and motivate people to work across units to realize the goals
Human resources procedures	o Make demonstrated collaborative behaviors a criterion for recruiting, promotions and compensation o Change performance evaluation criteria to focus not only on what was accomplished but how it was accomplished
Lateral cross-unit mechanisms	<u>Informal and formal networks</u> o Cultivate strong professional relationships o Cultivate and use connectors - people that have extensive networks within the company o Provide forums for people to get to know one another and develop personal bonds that facilitate sharing o Develop formal cross-unit groups and committees <u>Information systems</u> o Develop of electronic yellow pages listing experts by area o Develop benchmarking systems that allow employees to identify best practices in the company

Table 3: Management Levers (Hansen and Nohria)

However, collaboration just for the purpose of collaboration will not be productive. In order to limit unproductive collaboration it is important to guide the collaborative effort with proper performance management and clear goals, roles and responsibilities. A Cisco Executive Thought

Leadership publication[13] on collaboration recognizes that collaboration will grow in importance and become essential for future success as globalization continues, and that collaborating is not an activity that can be dictated by managers. Instead successful collaboration requires leaders who identify the right partners, paint their vision, form the right processes, communicate often, develop trust, and, most importantly, lead the way with goals, metrics, and incentives. The following seven ingredients were suggested as essential ingredients for successful collaboration:

1. Create a formal process to find the right collaboration partners
2. Plan, set goals, and follow up
3. Communicate openly, clearly, and frequently
4. Trust your partners
5. Lead
6. Establish metrics
7. Pay for success

Another Cisco publication[14] summarizing the results from a 2007 Economist Intelligence Unit survey sponsored by Cisco Thought Leadership lists the following insights: "Successful collaboration requires senior executives to get on board and a culture of sharing. Collaboration processes and metrics are critical, and currently collaboration tools are underutilized". About half of the companies in the survey had established cultures of trust and sharing between employees, and were interested in partnering with other organizations. However, only 25% of senior managers explain the benefits of collaboration, and examples of successful collaboration are rarely publicized. Furthermore, none of the companies rewarded people who collaborate well with greater autonomy. Finally, half of the companies lacked metrics to track collaboration, and 25% lacked formal processes for collaboration.

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[13] Astle, M. (2007), *What is wrong with collaboration: The need for Leadership,* Cisco Executive Thought Leadership Publication. http://www.cisco.com/en/US/solutions/collateral/ns340/ns856/ns870/Collab_problem.pdf

[14] Adams, E. J. (2008), *Solving the collaboration conundrum,* Thoughtleaders (Second Quarter 2008) http://www.cisco.com/go/thoughtleaders

3.2 Collaboration and Technology

> *"Believe it or not, the biggest barriers to collaboration are not the technical ones. I think that figuring out how to get the right kinds of human relationships, the right kinds of cultural expectations and, perhaps most importantly, the right kinds of incentives—those are the biggest barriers to effective collaboration."*
>
> - Thomas W. Malone, Professor of Management at the MIT Center for Collective Intelligence in a 2008 interview [15]

Today a wide range of collaborative technologies and software such as wikis, blogs, internet forums, web service, and video conferencing are available and continue to be developed to make collaborative communication and technologies available to an extremely large number of people. It is not surprising that there exist many articles discussing how powerful these collaborative technologies are in not only making it easy to find information and experts, but also in providing cross-unit linking mechanisms to improve collaboration. On the one side it is pointed out that most of these tools, although highly useful in reinforcing existing inter-company relationships, will likely not be the catalyst of new collaborative relationships. Hence, they fall short of becoming the truly disruptive innovation many predicted would revolutionize how companies interact and collaborate with each other. [16, 17] Others, such as Dr. T. Malone, take an opposite stance and are convinced that collaborative technologies will be disruptive and redefine teamwork, organizational behavior, and how people work and interact to reach common goals. Dr. Malone points to examples such as Wikipedia and Innocentive as evidence for how powerful the right combination of collaboration technology and organizational model can be.[18] One such promising use of collaboration technology may be the collaboratorium model which uses "a combination of internet-mediated interaction, collectively generated idea repositories, computer simulation, and explicit representation of argumentation to help large, diverse, and

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[15] Beveridge, C. (2008), *Intelligent Collaboration,* Thoughtleaders (second quarter 2008), www.cisco.com/go/thoughtleaders

[16] McAfee, A. P. (2006), *Enterprise 2.0: The Dawn of Emergent Collaboration,* MIT Sloan Management review, Spring 2006

[17] McAfee, A. P. (2005), *Will Web services really transform collaboration,,* MIT Sloan Management review, Winter 2005

[18] Intelligent Collaboration: A Discussion with Professor Thomas Malone, http://www.cisco.com/en/US/solutions/collateral/ns340/ns414/ns859/video_datasheet_collaboration.html

geographically-dispersed groups systematically explore, evaluate, and come to decisions concerning systemic challenges".[19] The collaboratorium model could be useful when the problem an organization faces is complex, there are many players to include and those players are geographically distributed, so that it would be hard to get them all in one room.[20] "Users will be able to share ideas, raise issues, specify options for these issues, analyze these options using simulation tools, discuss the relative merits of different options, and converge on collective decisions concerning which options to adopt. Tools for registering endorsements, maintaining reputation information, and identifying well-reasoned lines of argument will help users separate the wheat from the chaff" [19]. However, before such powerful collaboration technologies can be used successfully there has to exist an underlying drive and will of the people involved to collaborate with each other. The best technology combined with wrong use will result in, at best, ineffective, but potentially destructive or even harmful collaboration. For example, Dr. Malone points out that today's use of e-mail where people have to sift through potentially hundreds of mostly irrelevant messages per day to get to the few that are of value to them is a prime example of misuse of a very effective collaborative technology. Although there is nothing wrong with the technology itself, this type of collaborative technology misuse can actually make people less effective. The barrier to using these collaboration technologies effectively is ensuring that the underlying drive and will to collaborate exist, and learning how to use the technology effectively.

3.3 Collaboration and Knowledge Management

BusinessDictionary.com notes that collaboration is key to effective knowledge management, and it defines knowledge management as an "effective method of transferring know how among individuals, therefore critical to creating and sustaining a competitive advantage. Collaboration is a key tenet of knowledge management".[21]

In terms of knowledge sharing and collaboration within supply chains, stakeholders agree that sharing knowledge throughout the supply chain enables a more efficient supply chain and creates

[19] Klein, M, Malone, T. Sterman, J. Quadir, I (2006). *The Climate Collaboratorium: Harnessing Collective Intelligence to Adress Climate Change Issues,* Massachussets Institute of Technology, June 22, 2006 http://cci.mit.edu/collaboratorium.pdf

[20] Mangelsdorf, M. E. (2008), *A new way to collaborate,* MIT Sloan Management review, Vol 49, no. 3, Spring 2008

[21] BusinessDictionary.com 25 February 2009. http://www.businessdictionary.com/definition/collaboration.html

value for all stakeholders.[22] For example, it is well known that effective supply chain information flows allowing upstream supply chain partner transparency to end-customer demand reduces the bullwhip effect.[23] It is also known that tremendous benefits can be generated by creating and effectively managing channel restructuring through innovative inter-company operating partnerships.[24] Despite this common agreement there is still a high degree of reluctance to share knowledge between supply chain partners. In a study on how knowledge sharing enhances the performance of partnerships and the conditions that lead to knowledge sharing it was found that the difficulty of sharing knowledge is partly because benefits are not shared equally or simultaneously to all participants.[22] For example, the fact that buyers are closer to the point-of sale compared to suppliers', combined with the more frequent use of demand driven models means buyers will seize many efficiencies before the suppliers do. In addition, supply chain partners often see themselves as competing among themselves for revenue and are reluctant to participate in activities that could provide more benefit to partners than to their own company. There is also fear of knowledge leaking to competitors, and it was found that companies with thin margins were less likely to share knowledge compared to companies with greater margins. Interestingly, cross cultural differences (such as differences in perception of trust, time and risk taking) had no impact on the propensity to share knowledge. Table 4 outlines the conditions affecting knowledge sharing, Table 5 outlines the three levels of knowledge sharing important in supply chain partnerships, and Table 6 shows the knowledge sharing levels and details on who (supplier or buyer) benefited the most in each level according to Myers and Cheung's study.

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[22] Myers, M. B. and Cheung, M. (2008), *Sharing Global Supply Chain Knowledge*, MIT Sloan Management Review, Summer 2008

[23] Simchi-Levi, D., Kaminsky, P., Simchi-Levi, E. (2008), *Designing and Managing the Supply chain: concepts, strategies, and case studies,* 3rd edition, New York, NY, McGraw-Hill/Irwin, 2008

[24] Byrnes, J. L. S. and Shapiro, R. D., (1991), *Intercompany Operating Ties: Unlocking the Value In Channel Restructuring",* HBS Working Paper No. 92-058 (1991)

Condition	Details
Market Structures (economic and regulatory) for both buyers and suppliers	The greater the disparity between market environments, the greater the tendency to share knowledge
Environmental uncertainty (difficulty in forecasting, predicting competitor moves, and volatility in sales and market share)	The greater the uncertainty the more prone members are to share knowledge as companies want to reduce bullwhip effects.
Idiosyncratic investments or "specialty investments" for a specific supply chain relationship	The more investments specific to the partnership, the greater their propensity to share knowledge
Organizational fit	The more complementary and compatible company resources, goals and values are, the more prone companies are to share knowledge

Table 4: Conditions Affecting Knowledge Sharing (Myers and Cheung)

Knowledge Sharing Level	Details
Level 1 Information sharing	o Exchange of important data about sales, customer needs, market structures and demand levels
Level 2 Joint sense making	o The establishment of joint teams to solve operational problems, analyze and discuss strategic issues, and facilitate communication about the relationship help create a common understanding o Development of a relationship philosophy that stimulates productive discussion using both buyer and supplier viewpoints and significant face-to-face communication in the relationship.
Level 3 Knowledge integration	o Supply chain partners develop relationship-specific memories, providing everyone with a common understanding of idiosyncratic routines and procedures governing the relationship o Frequent adjustment of partners' common understanding of end-user needs, preferences, behavior, and trends in technology related to the business o Frequent evaluation and, if needed, adjustment of routines in order-delivery processes and updating of formal contracts in the relationship o Frequent refreshment of personal networks o Often resulting in collective problem solving that benefits both the companies and the relationship as a whole

Table 5: Three levels of knowledge sharing (Myers and Cheung)

Knowledge Sharing Level	**Who benefits more**
Level 1 Information sharing	o Suppliers benefit more from information sharing and knowledge integration no matter which partner actually shares the resource
Level 2 Joint sense making	o Buyers and sellers both benefited at an equal level when the suppliers developed the teams. o When buyers promoted the joint sense making activities, the suppliers reaped most of the benefits
Level 3 Knowledge integration	o Suppliers benefit more from knowledge integration

Table 6: Who benefits from knowledge sharing (Myers and Cheung)

3.4 Collaboration and Trust

Many agree that in order to collaborate and share knowledge there has to exist some level of trust between the stakeholders. Pirson and Malhotra define trust as the "psychological willingness of a party to be vulnerable to the actions of another individual or organization based on positive expectations regarding the other party's motivation and/or behavior".[25] Benefits of trust include improved cooperation with suppliers, increased motivation and productivity among employees, enhanced loyalty from customers and higher levels of support from investors. Pirson and Malhotra studied the importance of six factors; integrity, managerial competence, technical competence, benevolence, transparency and identification (or value congruence) on trust, and differentiated the factors across four archetypes of stakeholders; Customers, Suppliers, Employees and Investors. Perceptions of honesty and integrity are crucial for all stakeholders, but for people who engage with an organization on a regular basis, integrity is not enough. They must also perceive that the organization cares about their well-being. Benevolence toward the individual, not just good character and fair dealing is critical. Internal stakeholders (employees) look for managerial competence, while external stakeholders (Customers, Suppliers, Investors) look for technical know-how. Transparency (whether companies disclose information) seems to have little relevance in terms of building stakeholder trust. Value congruence (identifying with and sharing similar values) is important for all stakeholder groups, but matters most to employees.

3.5 Collaboration and Metrics

An old manufacturing proverb states: "You cannot change that which you do not measure".[26] Today it is common practice within supply chain partnerships to use scorecards to measure performance. Most often a buyer will use a supplier scorecard to keep track of supplier performance, ensure supplier accountability to certain metrics, and give incentives for suppliers to improve performance. In order to enable more collaborative supply chain improvement efforts Slobodow et.al[27] suggests expanding the scorecard concept from holding only the seller

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[25] Pirson, M., and Malhotra, D. (2008), *Unconventional Insights for Managing Stakeholder Trust*, MIT Sloan Management Review, Vol.49, No4, Summer 2008

[26] Source unknown

[27] Slobodow, B., Abdullah, O., Babuschak, W. C., (2008), *When Supplier Partnerships Aren't,* MIT Sloan Management Review, Winter 2008, Vol.49, No.2

accountable through the use of scorecards to, in strategic partnerships, also holding the buyer accountable through a two way scorecard. They argue that the greater transparency and incentive for dialogue achieved through dual accountability lead to a deeper understanding of issues on both sides. This deeper understanding results in stronger partnerships, improved collaboration to solve underlying issues, and other cost and service level benefits. It is suggested the seller be accountable for service levels, on-time launch, cost improvements, quality defects, and finished goods inventory. While the buyer takes accountability for forecast accuracy, on-time specifications, cash flow, process capability versus product specifications, and total supply chain inventory. A two way score card will likely help inter-company collaboration by increasing understanding about each company's challenges and sharing accountability for improvement. Another more novel approach to measuring how well a group of people collaborate is through the concept of collective intelligence. [28] By measuring the collective intelligence of a group, i.e. how well and quickly the group can adapt to new environments, challenges, situations and come up with and execute novel solutions, the group will be able to use that information to alter it's structure, processes, behavior or composition to improve collaboration and increase the collective intelligence.

[28] Intellignet Collaboration: A Discussion with Professor Thomas Malone, http://www.cisco.com/en/US/solutions/collateral/ns340/ns414/ns859/video_datasheet_collaboration.html

4 Order Fulfillment Process Map Analysis

The following chapters present data collected in order to characterize Cisco and Flextronics collaboration with a specific focus on Cisco's Lean 2.0 Initiative. Several different approaches and tools were used to collect the data including end-to-end order fulfillment process mapping, a three lens analysis[29], and a survey from existing literature. Results and recommendations from each approach are discussed in chapters 4, 5, and 6 respectively. In addition, a dynamic simulation is presented with the goal of addressing a specific collaborative pain point associated with Cisco's Lean 2.0 Demand Pull initiative. The details of the dynamic simulation is discussed in chapter 7.The final chapter provides a conclusion and summary of the recommendations made.

4.1 Process Mapping

In order to better understand the extent of collaboration and interaction between Cisco and Flextronics the joint end-to-end order fulfillment process is mapped out. The map is assembled partly from existing Cisco and Flextronics process maps, and partly from information gathered through interviews with Cisco and Flextronics employees. Starting from an order being entered into Cisco's order information data bases and ending with the carrier delivering the order to the end customer, the complete map covers of over 400 major process steps within 24 main processes. Figure 1 shows a high level process map of the 24 main processes from order to delivery. Tables 7 and 8 outline the main Cisco and Flextronics processes included in the end-to-end order fulfillment map as well as the number of major process steps in each process.

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[29] Carrol, J. S. (2006), *Introduction to Organizational Analysis: The Three Lenses,* MIT Sloan School, Revised June 2006

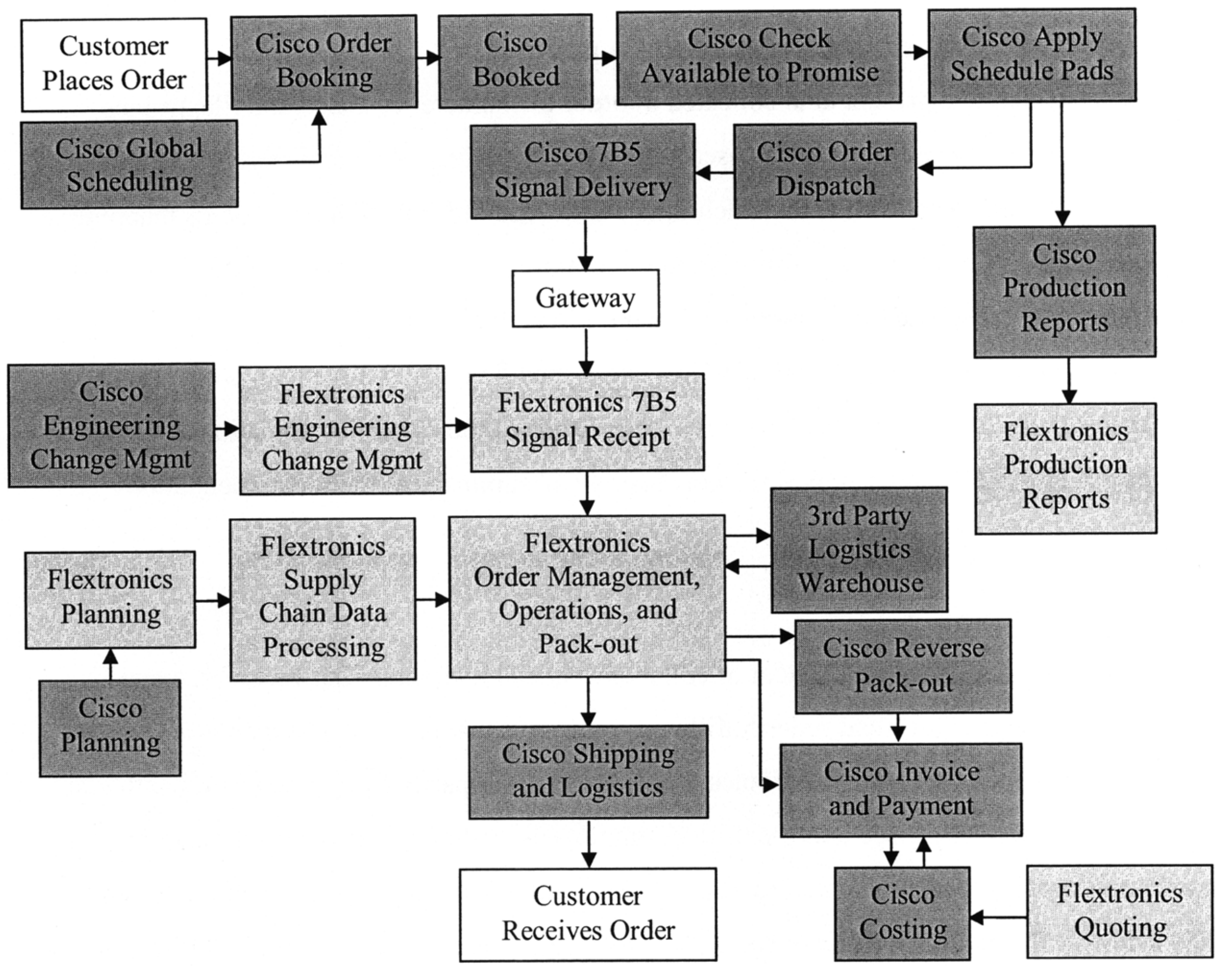

Figure 1: High level Cisco and Flextronics End-to-end order fulfillment process map

Cisco Processes	**Process Steps**
Global Scheduling Process	11
Order Booking Process	6
Cisco Booked Process	3
Check Available to Promise Process	38
Apply Schedule Pads Process	16
Planning Process	23
Engineering Change Management and Global Engineering Change Order Process	36
Order Dispatch Process	12
7B5 Signal transmission Process	8
Costing Process	59
Automated Vendor Payment - Invoice and Payment Process	38
Shipping and Logistics Process	19
Reverse Pack-out Process	20
Production Reports Process	1

Table 7: Cisco End-to-end Order Fulfillment Processes and number of major process steps

Flextronics Processes	**Process Steps**
Planning Process	33
Engineering Change Management and Local Engineering Change Order Process	25
Supply Chain Data Processing	17
7B5 Receipt and Reconciliation Process	16
Order Management, Operations, and Pack-out Process	34
Third Party Logistics Warehouse Process	8
Quoting Process	9
Production Reports Process	2

Table 8: Flextronics End-to-end Order Fulfillment Processes and number of major process steps

4.2 Collaboration Touch points

For these processes to function, numerous interactions or collaboration touch-points have to occur between Cisco and Flextronics. For example, goods are transported, data and information is shared, payments are delivered, questions are asked, answers are given, problems are solved, and decisions are made. These interactions occur through several channels such as automatic data transfers, e-mails, phone calls, and meetings. Overall, 33 touch points were identified in the end-to-end order fulfillment process map. Although there are certainly more touch points occurring in these processes, these 33 were the ones specifically observed, mentioned during employee interviews, or found in company documentation and materials. Figure 2 depicts the 33 inter-company touch points and the processes connected by those touch points. Note that for simplicity Figure 2 excludes processes that are not part of inter-company collaboration. Any internal touch points are also excluded from Figure 2. Figure 2 shows that certain processes rely more on inter-company collaboration than others. For example, the costing and quoting processes and the engineering change management processes are most reliant on inter-company collaboration with 12 and 9 touch points respectively.

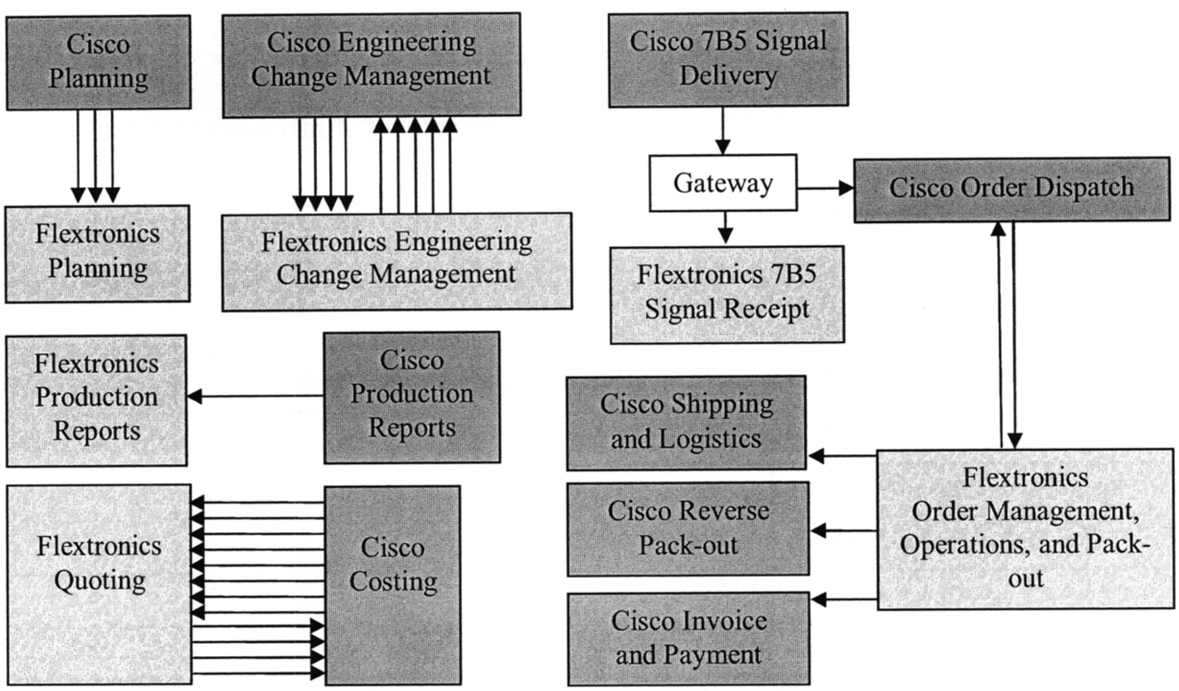

Figure 2: Cisco and Flextronics end-to-end order fulfillment process touch-points

4.3 Collaboration Pain Points Overview

In order to improve collaboration it is necessary to determine which of the inter-company interactions and processes are functioning well and which represent opportunities for improvement. By asking the Cisco and Flextronics employees who use these processes and interactions in their daily jobs what they feel is painful and wasteful in their jobs, pain points can be identified and added to the end-to-end order fulfillment process map. Figure 3 depicts these pain points as red stars. The placement of the red star indicates which process the pain point is associated with. Note that for simplicity Figure 2 excludes those pain points associated with processes and touch points not part of inter-company collaboration. In addition, Figure 3 only shows the quantity of pain points identified and not the magnitude of the pain or what the pain is. It is highly likely that many more pain points exist that were not identified though the interviews and observations made in this study.

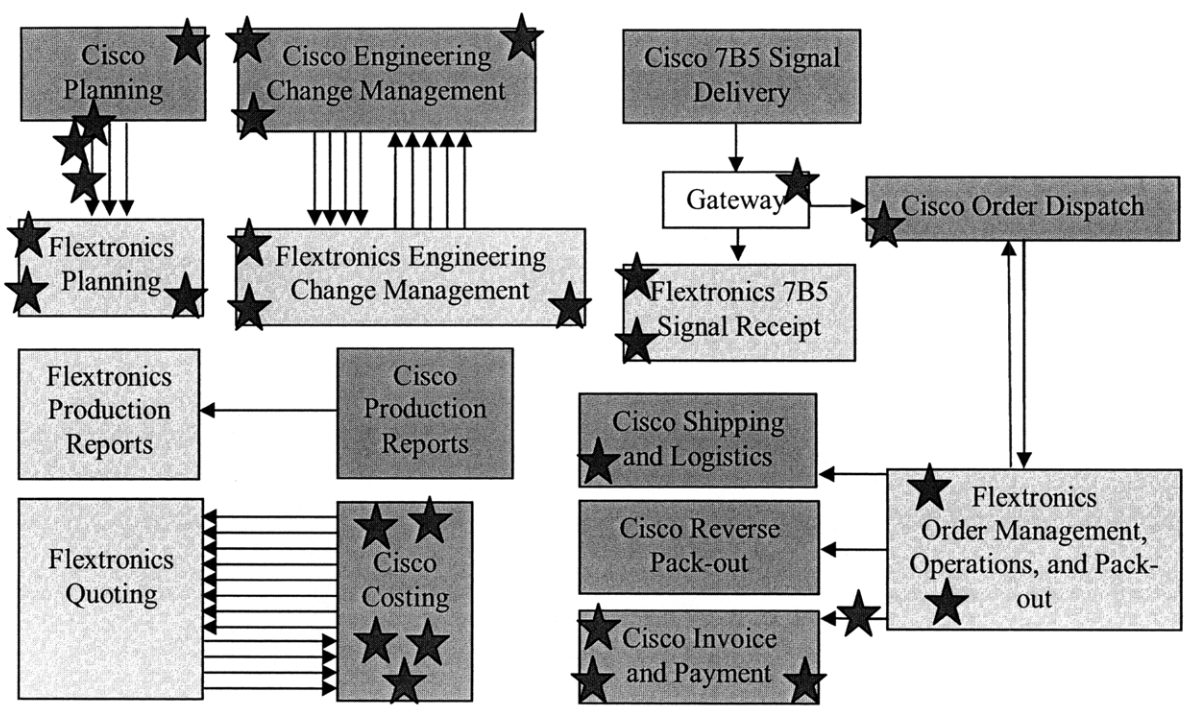

Figure 3: Cisco and Flextronics end-to-end order fulfillment process pain-points

Many pain points deal with similar issues, hence grouping the pain points based on similarities makes it possible to identify a few common themes. Grouping also allows for better understanding of the pain identified and instead of generating separate recommendations for each specific pain point, more general recommendations addressing the majority of the issues can be made. Based on similarity, the pain points were categorized into the following groups:

- Managing payment and Bill of Material (BOM) Processes in two ERP Systems
- Cisco Buyer Role and Responsibilities
- Company Culture and Behavioral Drivers
- Engineering Change Order Process
- Cisco Lean 2.0 Initiative
- IT resource constraints
- Forecast and Supply Capability Reporting

Figure 3 represents the quantity of pain-points in each group and which company, Cisco or Flextronics, the employees who brought up the pain points belong to.

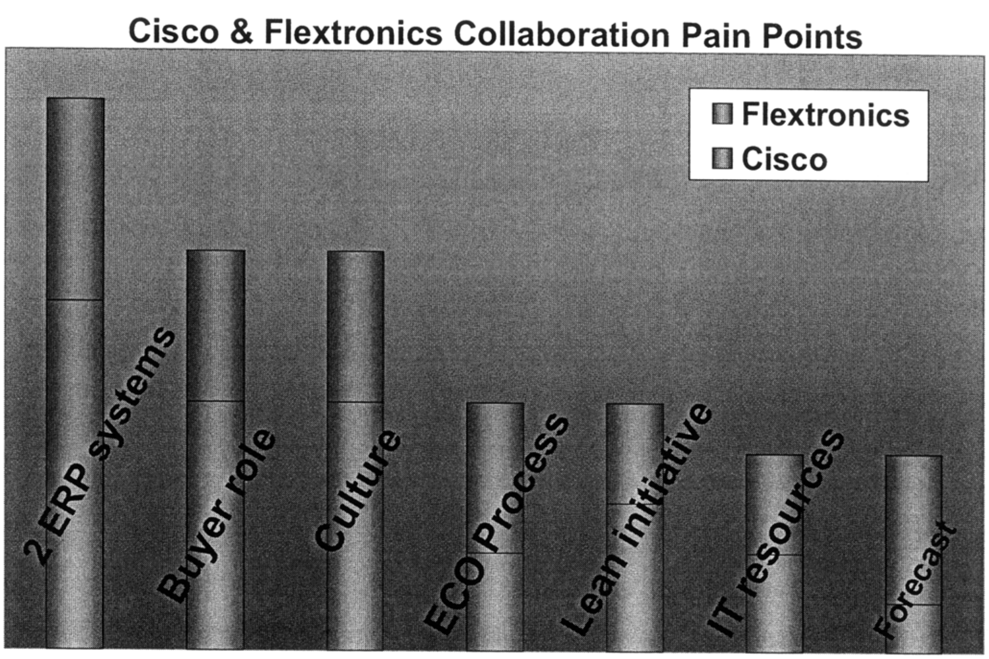

Figure 4: Cisco and Flextronics pain points

4.4 Collaboration Pain Points Details

Before probing deeper into the details of the pain points, it is worth pointing out a couple of overarching themes that were found while observing and conducting interviews with Cisco and Flextronics employees. First, although this work focuses on problems and issues that exist between Cisco and Flextronics, I want to point out that Cisco and Flextronics do have a very positive relationship and the majority of employees within each company that I spoke to have high regards for the employees in the other company. Cisco employees often pointed out that Flextronics was one of their best manufacturing partners to work with. Similarly, Flextronics employees many times pointed out that Cisco was one of their best customers to work with. Another interesting finding was that pain points brought up by Flextronics employees dealt with pain felt within Flextronics. However, Cisco employees would often identify pain they believed Cisco was causing Flextronics. For example, as one Cisco employee explained "Our (Cisco's) buyers are not deactivating BOMs (Bills of Materials) as they should, which causes ECOs (Engineering Change Orders) to be triggered to the wrong manufacturing partner". Another Cisco employee stated that "We (Cisco) often come up with concepts and move to implementation before fully understanding the full requirements needed of the manufacturing partner". A third example brought up by a Cisco employee "We (Cisco) pay Flextronics at pack-out so there is an incentive for them (Flextronics) to build early, to stop this we (Cisco) started limiting the order visibility given to Flextronics to only 15 days ahead of the desired factory completion date when visibility to booked orders would allow Flextronics to ensure they have material on hand". Apparently many Cisco employees are aware of pain Cisco is causing their manufacturing partners, but for various reasons they feel unable to do anything about it. As one Cisco employee put it "We know what needs to be fixed but it is difficult to get funding for projects" and another stated "We have short term focus and we don't see the ROI of longer term projects such as removing Oracle from the CM's (Contract Manufacturers) even though we know it is causing a lot of pain and wasted resources. We also leave many projects incomplete".

The following section provides further details about some of the pain points identified.

<u>Managing payment and Bill of Material (BOM) Processes in two ERP Systems:</u> Cisco requires, through the order fulfillment process, Flextronics ability to process sales order updates, pack-outs, and shipping in Cisco's ERP system (Oracle). However, since Flextronics owns the

inventory and the inventory resides in Flextronics ERP system (SAP), Flextronics must also back flush, or consume, the inventory in their SAP system. Today, Flextronics maintains the Bills of Material for configured products on Cisco's ERP system, and Cisco's ERP system then issues a work order and invoices off that work order. This is a very complex process. In order to validate payment to the invoice Flextronics maintains a very complex vendor payment reconciliation process. Managing these two systems and associated "band-aid" solutions developed leads to waste of resources for Cisco and Flextronics. In addition it causes a ripple effect of problems in processes throughout the two organizations. Cisco has made attempts to resolve this issue. For example, in their Lean 2.0 DF Simplification Initiative it was proposed that Flextronics should be allowed to receive the Cisco-based sales orders, generate their own work order, ship, and then invoice direct to Cisco. However the ROI was not considered adequate to continue the initiative and the initiative was abandoned.

Cisco Buyer Role and Responsibilities: Cisco buyers interact and collaborate daily with their counterparts at Flextronics and other Cisco manufacturing partners. Acting as a link between Cisco and its manufacturing partners, the buyer role is important in ensuring successful implementation of collaboration initiatives and in ensuring business processes are sustained and working as intended. The buyers' role and responsibilities are changing with the ongoing Lean initiatives, as are the processes and tools used by the buyers. In addition, there are discrepancies between Cisco business units (BU's) in the processes they use, the metrics they track, as well as how they perform internal and external reporting. These differences cause additional confusion and work for the buyers and leads to problems such as inaccurate or missing partner payments.

Company Culture and Behavioral Drivers: Cisco and Flextronics' different organizational structure, culture, and political climate can result in pain and collaborative barriers between the two companies. For example, it is part of Cisco's culture for people to change roles more frequently than within Flextronics, causing discontinuity of Cisco team members taking part in long term projects. This discontinuity causes confusion and frustration and team productivity often suffers while new team members are brought up to speed. Chapter 5 provides further analysis of barriers resulting from structural, cultural, and political differences using an approach called a three lens analysis.

Engineering Change Order Management Process: The Engineering Change Order (ECO) Management Process is of high importance as it ensures any changes and improvements in product specifications are transferred from Cisco engineering to manufacturing at Flextronics. As discovered in the process mapping the ECO process contains a large number of process steps and touch points: 36 Cisco process steps, 25 Flextronics process steps, and nine Cisco/Flextronics touch points. Most of the touch points are communication through e-mails and phone calls between Cisco and Flextronics engineering change order employees. During interviews the ECO process was often referred to as very painful. For example, having a large amount of change orders can cause sales order problems, and when the change orders become stacked the chance for serious error increases. Dealing with these issues eats up valuable employee time for both Cisco and Flextronics employees. During Cisco's Lean 1.0 initiative Cisco and Flextronics made attempts to deal with these issues by establishing a joint ECO procedure with checklists to be followed and collaboration phone calls as part of the procedure. But at the time these interviews took place only one Cisco Business Unit (BU) was following the agreed upon procedure and checklists. As one Flextronics employee pointed out: "The ECO checklist is not used, no advance release notice is given, and the collaboration meetings are no longer held. We (Flextronics) would be able to determine the estimated cut-in dates much quicker if we were given advance notice as agreed in Lean 1.0". Instead of a functioning and stable process there now exist a disconnect between Cisco and Flextronics employees responsible for the ECO process. A Cisco employee pointed out that "We need better accuracy for when a contract manufacturer can make an ECO change, we don't know who at Flextronics is responsible for giving us the data".

Cisco Lean 2.0 Initiative: As part of Cisco's Lean 2.0 initiative, Cisco is implementing a forecast driven demand-pull replenishment system throughout their supply chain. Cisco expects the new replenishment system to result in minimized inventory exposure, increased supply chain flexibility, and speed to customer. The Flextronics team involved with implementation worries that the methodology is unproven and that it may introduce supply chain risks for certain products or situations. While the Cisco team is pushing forward with implementation to meet project deadlines, the Flextronics team continues to question the validity and value of the proposed methodology. The added value analyses performed by Cisco to date have not been adequate to fully convince the Flextronics team. The different perspectives around the potential benefits and risks with the new system detract from effective collaboration and causes friction between Cisco and Flextronics implementation teams. Chapters 5, 6 and 7 provide more details on the collaboration pain points within Cisco's Lean 2.0 Demand Pull Initiative.

Forecast and Supply Capability Reporting: Cisco has undergone a tremendous effort to improve their forecasting accuracy to lessen the pain involved with forecast changes. Despite this effort, Flextronics often do not trust the Cisco forecast presented to them. One Flextronics employee explained "The forecast sent from Cisco to Flextronics changes frequently but Cisco cannot validate why the forecast changed. Since we (Flextronics) don't understand why the forecast changes we don't trust the forecast accuracy". Flextronics also expressed apprehension about the fact that the forecast validation collaboration calls, the forum in which questions about the forecast could be asked, were being eliminated. On the supply side, both Cisco and Flextronics felt pain due to issues with Cisco's request to have Flextronics provide them with a supply capability report (SCR). A Cisco manager explained: "We don't know what our partners true capabilities are so we cannot be proactive with demand planning, demand shaping, and promotions. Currently we have to check every scenario with the CM's. We would like improved supply capability reporting, the accuracy is good, but make it more complete and more systemic". The need to make the report systemic was shared by Flextroincs but with a different spin: "We give Cisco our SCR but Cisco still commonly has a burst in orders that require us to scramble to get material, it doesn't seem like the SCR is linked to Cisco's Order Management tool".

4.5 Recommendations

Addressing the pain points identified above presents unique opportunities for Cisco and Flextronics to improve their collaboration in the end-to-end order fulfillment process. The four recommendations presented below are general enough that they address the majority of the pain points identified.

1. Cisco and Flextronics should jointly re-evaluate the ROI of removing Oracle from its contract manufacturing partners' sites. Both Cisco and Flextronics employees stated that many of the pain points identified in the end-to-end order fulfillment process map ultimately

were ripple effects from this issue. It is important to make sure to take time upfront before performing the analysis to ensure all manufacturing partners buy in to and trust the methodology and data that will be used. Preferably the partners should take an active role in performing the analysis since they are all affected by the same issue. Trusting that all feasible alternatives have been thoroughly and accurately evaluated will make it easier to accept the outcome of the analysis.

2. Cisco buyers act as a link between Cisco and its partners and the buyer role is important in ensuring business processes are sustained and working as intended. Cisco and its partners should work to identify different practices across business units and partners, and understand how the buyers' role, responsibilities, and performance affect the outcome of existing business processes. This understanding will allow changes and adjustment to be made to buyer responsibilities, training, tools, processes, incentives, and metrics to ensure successful outcomes in existing business processes as well as ensure future collaborative initiatives are not negatively impacted by buyer performance. Part of this project can be to deep dive into the ECO process to identify opportunities for improvement.
3. Cisco and Flextronics should work together to identify the impacts of forecast accuracy and forecast changes in terms of labor management, capacity, floor space, material, inventory levels, expedites, etc. Similarly the impact of Supply Capability Reporting should be identified. This joint understanding should then be used to guide development of common processes, tools, and communication links to quickly identify and communicate forecast changes and supply capability.
4. Cisco and Flextronics should work together to quantify the impact of implementing their Lean 2.0 Forecast Driven Demand Pull replenishment methodology on supply chain metrics. Providing data that both Flextronics and Cisco can trust will remove the hesitation felt by both Flextronics and Cisco team members. Chapter 5 and chapter 7 provide further discussion on this topic.

Mapping the end-to-end order fulfillment process and finding inter-company touch and pain points provides a way to identify existing collaboration links between Cisco and Flextronics as well as understand the collaborative pain inherent in their joint processes. At fist glance, the pain points identified on the map may seem like discrete events, but after digging a bit deeper into each issue, it is clear that there are similarities among the pain points. Organizing the pain points into groups based on similarities allows four specific recommendations covering the majority of the pain points to be proposed. The following chapters provide further study of one of the pain points identified: collaboration within the Lean 2.0 Demand Pull initiative.

5 Three Lens Analysis of Cisco's Lean 2.0 Demand Pull Initiative

Mapping out the joint end-to-end order fulfillment process allowed for identification of a suitable joint collaborative initiative and a specific pain point to study further: Cisco's Lean 2.0 Demand Pull initiative. This chapter first provides background on the initiative. Then a Three Lens Analysis[30] using strategic, cultural, and political perspectives to analyze Cisco and Flextronics collaboration within this initiative is provided. Since interpretation of data collected is influenced by the perspective used in making the observations, the Three Lens Analysis helps identify possible reasons for why there exists pain within this initiative. Based on findings from the Three Lens Analysis recommendations on how collaboration can be improved within the initiative are made.

5.1 Lean 2.0 Demand Pull Initiative Background

> *"The marketplace is telling us that it is not just product innovation that is important but also the supply chain innovation that goes along with it....those companies that integrate their supply chain capabilities and do true concurrent supply chain architecting along with product architecting are the ones that will be most successful."*
>
> -Prentis Wilson, Vice President of Product Operations for Cisco Systems[31]

A few years back Cisco started implementing their Lean 1.0 initiative to establish pull manufacturing across key areas of their supply chain. Last year, through Lean 2.0, Cisco extended the lean concept further across their supply chain in order to reduce operational complexity for themselves and their manufacturing partners and suppliers. Lean 2.0 is comprised of three main tracks: the Demand Pull track which intends to stabilize and optimize the end-to-end Demand Pull operations across Cisco's supply chain, the Supply Chain Visibility track which intends to enable end-to-end visibility of Cisco's supply chain, and a track focused on completing

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[30] Carrol, J. S. (2006), *Introduction to Organizational Analysis: The Three Lenses,* MIT Sloan School, Revised June 2006

[31] Murphy, J. W. (2008), *What a bright idea: Innovation stems from convergence of design, supply chain excellence,* www.supplychainbrain.com/content/headline-news/single-article/article/what-a-bright-idea-innovation-stems-from-convergence-of-design-supply-chain-excellence/ August 14, 2008

Lean 1.0 implementation.[32] The Demand Pull track is a close collaboration effort between Cisco and their manufacturing partners (Flextronics, Foxconn, Celestica, and Jabil) to implement a new replenishment methodology throughout the supply chain. The goal is to: minimize inventory exposure, increase supply chain flexibility and speed to customer, and ensure consistent, scalable, and sustainable processes are used. Simply stated Demand Pull is a forecast driven pull system where the forecast is used to predict how a pull system will react. Reorder Point Levels are pre-planned and rules are set up in an attempt to reduce "churn" such as rescheduling activities in the system. Within this initiative collaboration between Cisco, component suppliers and contract manufacturers is key to successful implementation.[33] The involved parties are responsible for developing, reviewing, agreeing to and approving the procedures, standards, and requirements to be used. During the initiative the team uses a Business Requirements Document (BRD) to outline the key concepts and high-level requirements of the initiative. At the time the first draft of the Demand Pull BRD was released Cisco's manufacturing partners also signed-off on the conceptual design. The parties then continued work on the detailed design phase, and the tasks of writing the detailed specs were distributed among the involved parties.

The collaboration I have observed within the Lean 2.0 Demand Pull initiative is very impressive and there are a lot of things that are being done very well. For example, the Demand Pull leadership team has created an environment where Cisco's four contract manufacturing partners (Celestica, Foxconn, Flextronics, and Jabil) openly share information to make this initiative work even though they are competitors. I have also found that there exists great respect between Cisco and Flextronics employees. But, as discovered during the end-to-end order fulfillment mapping, there also exist some pain within this initiative. Among Cisco the Demand Pull replenishment methodology is considered revolutionizing and it is expected that this new system will result in reduced inventory costs and a more responsive and flexible supply chain. However, some people in Flextronics and within some of the other partners worry about the methodology being unproven and that it may introduce risk for certain products or situations. Cisco's Lean 1.0 initiative had a clear burning platform; to make sure that the massive inventory write-off of 2002

[32] Cisco Lean 2.0 Demand Pull Team (2008), *Lean 2.0 - Demand Pull, Business Requirement Document,* Cisco Internal Document, Revision 1.0, April 25, 2008

[33] Mendez. A. (2006), *Using Collaboration to improve supply chain value,* http://www.cisco.com/en/US/solutions/collateral/ns340/ns856/ns870/Building_on_Experience.pdf

would never occur again. By using Lean principles the goal of Lean 1.0 was to move from a forecast driven push methodology towards a pull methodology driven by actual orders. During Lean 1.0 implementation there was a lack of coordination between the teams responsible for implementation at each contract manufacturer. Progress occurred at varying rates between each contract manufacturer and when Lean 1.0 was over, some contract manufacturers were fully implemented whereas others were only partly implemented. There also existed several ways to perform the replenishment calculations and it seemed that each contract manufacturer was using a different calculation. Simultaneously with Lean 1.0 implementation there was also another, separate effort within the Cisco supply chain organization to improve Cisco's forecasting capability. This improved forecasting capability was intended to be used to forecast actual material replenishment requirements. These two initiatives, Lean 1.0 and improved forecasting both had the same goal; reduce inventory risk. However, the approaches taken to achieve this goal were very different and some Cisco employees say they were greatly misaligned. I have found that within both Cisco and Flextronics there exists an unspoken belief that the real purpose of the Lean 2.0 Demand Pull initiative is to justify investment in these two misaligned approaches by combining them into one. Whether or not this is true may not be as important as the fact that this belief exists since it results in doubt of the viability of the Demand Pull methodology. Additional information regarding the Lean 2.0 and Demand Pull system will follow in upcoming sections and chapters.

5.2 Three Lens Analysis - Strategic, Cultural, and Political Factors

This chapter provides an organizational processes analysis called the three lens analysis using strategic design, cultural, and political perspectives as basis for the analysis[34]. The purpose of the analysis is to: first provide an objective and unbiased perspective of both Cisco's and Flextronics' supply chain organizations and their efforts to collaborate within the Lean 2.0 initiative, then use insights to identify areas of improvement, and finally provide recommendations for how to improve.

[34] Carrol, J. S. (2006), *Introduction to Organizational Analysis: The Three Lenses,* MIT Sloan School, Revised June 2006

5.2.1 Strategic Design Perspective

Cisco is a large matrix organization and can be very confusing to navigate. There seems to be several teams and departments working on the same things and there are a multitude of initiatives and projects going on to improve or expand the business. Strategy is communicated well within the company through several channels. For example, there are quarterly open forums where the CEO talks about the current state and future vision of the company and industry. These are recorded and can easily be accessed through the intranet. The employees place importance in being aware of the company strategy which is communicated by top management listing out the major focus areas of the company. These focus areas are then used by managers to guide resource allocation decisions within teams and ensure that there is alignment between the projects that are being worked on and the overall company strategy.

The organization within Flextronics involved with the Cisco account consists of the former Solectron business, and structurally it still functions in much the same way as Solectron did (Flextronics acquired Solectron in October of 2007). Flextronics' focus is simple and clear: "creating value that increases customer competitiveness". This slogan is displayed throughout Flextronics in various forms. Flextronics customer focus permeates the organization including its structure. The majority of the organization consists of account teams, each responsible for one customer. Within an account team the structure is fairly hierarchical. Account teams are siloed from one another as the majority of people are focused on one account only. Top executives and senior managers seem to be the only ones that are included in meetings communicating the company strategy, and the efforts to communicate those details to the rest of the company appear to be minor or not very successful. For example, the CEO has a blog on the Flextronics intranet, but it is not updated very often and people do not seem to take time to read it.

Figure 5 depicts the formal structure of the Lean 2.0 initiative. The steering committee and partner executive sponsors ensure that the initiative is prioritized and adequate resources are available. Each working team consists of representatives from Cisco and each partner company, and the teams are focused on a specific part, or track, of the initiative. This focus facilitates quick action but also poses a risk as each team's activities and decisions affect the other teams. If there is a lack of communication between the teams the whole project may stall if two teams come up with solutions that are conflicting. The track PM (Program Manager) and PMO (Program Management Office) provide the link between the teams and ensure that individual team efforts support each other and the goal of the initiative. A share point site, several partner summit meetings, biweekly Lean 2.0 Steering committee meetings, and a Business Requirements Document are some of the ways used to ensure alignment and coordination of the individual teams. This initiative has strong top to bottom linking within the Cisco organization which helps connect the individual team efforts to the long term strategy and vision of Cisco to become lean.

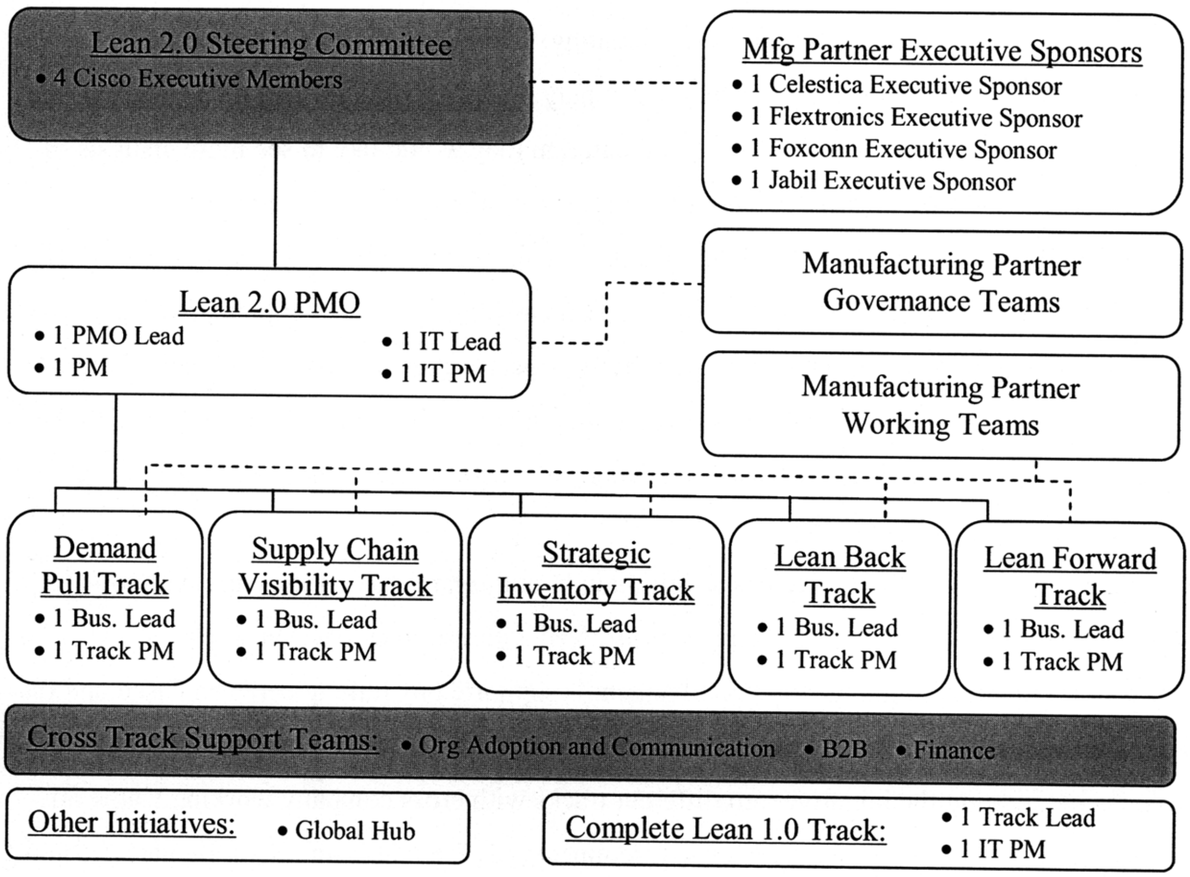

Figure 5: Lean 2.0 Organizational Structure[35]

Within Flextronics linking between the Lean 2.0 efforts to company strategy exist, but is not as extensive. There is clear linking between Lean 2.0 working teams' effort and the goal of providing customer value; however the Lean 2.0 initiative may not necessarily link to Flextronics overall company strategy and vision. The Flextronics team involved with the Lean 2.0 initiative is also part of Flextronics' Cisco account team. This account team is responsible for representing

[35] Organizational Structure chart presented in Cisco Lean 2.0 Partner Summit Presentation, September 2008

and managing Flextronics participation in several large Cisco supply chain initiatives, one of which is the Lean 2.0 demand pull initiative. Through interviews and observations I have found that the people within this Flextronics team are not as comfortable implementing the new Demand Pull system as the Cisco team is. In meetings, the Flextronics team often questions the validity of the methodology, even though a decision had been made to "agree to disagree" and move forward with implementation. It is clear that the Flextronics team would rather proceed more carefully to avoid problems they are anticipating. The Flextronics team worries that the Demand Pull methodology is unproven and that it may introduce risks for certain products or in certain situations. Before embarking on implementation they would like to see more analysis of the new system to ensure identify potential risk and ensure mitigation plans are incorporated early on. On the other hand the Cisco team responsible for managing and executing Lean 2.0 is focused on meeting implementation deadlines and on ensuring successful implementation across all manufacturing partners. From a Cisco perspective, there is a great sense of urgency to meet the planning deadlines and the Cisco folks would like the manufacturing partners to agree to the proposed methodology and, as expressed in an interview with a Cisco employee, "just say yes and move on with implementation".

In summary, the Lean 2.0 initiative has a well thought out organizational structure with top to bottom linking ensuring that the initiative is prioritized and resources are available. Manufacturing partner alignment and involvement is supported by linking between Cisco and the manufacturing partners on each level. The structure also facilitates cross company collaboration and focus by dividing the initiative into different tracks with cross company working teams for each track. Despite this structure there exist disconnects between the manufacturing partners and Cisco. While Cisco is pushing to move on with implementation, Flextronics participants are still not convinced that the Demand Pull methodology is robust and want to slow down and move forward more carefully. Cisco can help get the Flextronics team on board by providing data and analysis addressing Flextronics concerns and tailoring the presentation specifically to Flextronics. Cisco can also work with Flextronics Lean 2.0 Executive sponsors to provide a stronger link between the Lean 2.0 initiative and Flextronics strategy, vision, and incentives such that the Flextronics team feels that the effort they are putting into the initiative is providing value to their own organization in addition to benefiting their customer.

5.2.2 Cultural Perspective

The majority of the Flextronics Lean 2.0 team members are former Solectron employees and they have kept much of their Solectron culture. For them work is all about face time and about getting through the day. Roles and responsibilities are clearly defined and well structured. Emphasis is put mainly on sustaining work compared to project work. However, in the account team responsible for Cisco there are a lot of projects going on which causes some frustration. Account teams strive to be the team that brings in the most money for the company. At Flextronics most of the work is performed at the office in the cubes. The teams naturally become closely united both physically and mentally as they often have cubes next to each other and they work to get through the day together in the office. Flextronics account teams have a tendency to take on the culture of their customer. The former Solectron folks, due to their history of working with Cisco, are very much in-tune with how Cisco works and have also taken on some of Cisco's culture. For example, as a former Solectron employee stated: "Since it is so common for Cisco employees to work remotely, it is also more common for the Flextronics Cisco account team members to work remotely more often compared with other Flextronics teams". The Flextronics members of the Cisco Lean 2.0 team are Flextronics employees from Texas, California, and Europe. They do not all physically sit together and hence lack some of the unity found in other Flextronics teams.

Cisco has a much more flexible, ambiguous, and unstructured work environment. People often refer to Cisco's work environment as having the feel of a startup. People at Cisco are very eager to help each other and to build their networks. The flexible work environment results in people not spending much time at their desks and teams do not become united naturally. At Cisco the major emphasis of a team is to become, or prove that it is an important and significant contributor to Cisco's overall business. Project work receives much attention compared to sustaining work. Importance is placed on coming up with, working on, and completing big initiatives and projects. The better the project and its execution, the more attention and rewards the team receives. As one Cisco employee put it "there is a quest for glory", and sustaining work is viewed as important but much less glorious compared to project work. At Cisco people move job roles often, which mean that there is a lack of history in a long lived initiative like the Lean initiative. Confusion and frustration is created when a new Cisco person comes in on a team that has been in place for a while. The manufacturing partners have to redo and re-communicate to bring the new Cisco person up to speed and the team goes through another cycle of forming, storming, and norming before they can perform again. On the other hand, the rotation of people ensures that new ideas and energy is introduced.

At Flextronics people stay in their roles and teams for a longer time. This allows for teams to build history and bonds which increases trust. But if past history has been negative there is also a memory that can be difficult to change. Flextronics have fewer resources dedicated to working on the Lean initiative compared to Cisco. Many of the Flextronics people that are sitting on the project teams have other responsibilities consuming most of their time. Many are working on multiple Cisco projects simultaneously, or they have responsibilities that at Cisco are divided between multiple people. This means that the success of joint projects from a Flextronics standpoint are tied strongly to the particular person involved with the project since they are often the only Flextronics employee taking part in the project. From a Cisco standpoint, since the team consists of many more people, success is less dependent on a particular person and more dependent on the ability of the team to execute. Flextronics folks often express being overwhelmed and frustrated about supporting the many different projects and initiatives that Cisco is driving. Cisco, on the other hand is worrying about project schedule slip and implementation failure. Although there is a co-dependence and much respect between Cisco and Flextronics employees, the teammates involved in the Lean initiative sometimes refer to each other as difficult to work with which has created a divide and a barrier in getting work done. On a positive note the divide can be overcome. For example, the fact that Cisco and Flextronics created a joint LFM internship is a clear symbol of the commitment from both companies to strengthen their relationship and improve collaboration. It symbolizes Cisco's commitment to collaborating with their contract manufacturers to create value for all parties, and it symbolizes Flextronics customer focus and desire to accommodate and work well with Cisco to create value for their customer. The attitude of people including senior executives within both companies has been positively affected just by them learning of the existence of a joint internship. In addition, the joint internship symbolizes a willingness and desire of both companies to learn and to gain an outsider's perspective.

5.2.3 Political Perspective

People within both organizations have expressed a need to have an outsider's perspective on the challenges the Demand Pull initiative are dealing with. There also exists a desire for this outsider to be honest and openly communicate observations and discoveries without "sugar coating". When learning about the Lean 2.0 initiative I discovered that it was very difficult to find communication around what the driving force or burning platform for the Demand Pull initiative was. In such a massive multi-company initiative I was sure I would find a burning platform that had been used and communicated extensively to give the involved people the energy and passion needed to drive this initiative. In my search for communication around the burning platform I found that Cisco managers agree that the purpose of Lean 2.0 is to provide consistency. The Lean 1.0 effort resulted in various interpretations and implementations of how to calculate ROP (Reorder Point) levels and Lean 2.0 is supposed to remove that variation and provide a platform for further improvement. However, consistency could have been achieved and variation removed without embarking on the Demand Pull initiative. As a matter of fact, consistency constitutes the burning platform of the third main Lean 2.0 track, to complete Lean 1.0 implementation. Through my interviews I found that there are employees within both Cisco and Flextronics who believe that the reason and burning platform for the Demand Pull initiative was to justify investment made in two misaligned projects, the Lean 1.0 project and the forecast accuracy improvement project, by combining them into one methodology. Even if this belief is not true, the perception that it may be true creates political tension and a collaborative barrier within this initiative as it makes people less trusting and less willing to give their buy in to the initiative.

5.3 Recommendations

From my observations within this current joint initiative the major finding is that the value of the initiative was not clear to all participants prior to moving on with project execution. There was not enough communication of a burning platform for the organizations to rally around, and people within both Cisco and Flextronics doubt whether the purpose of the initiative is legitimate. Therefore the initiative is, and has been, relying on Cisco's power as the customer to be the driving force behind project execution. If Cisco had been able to convince it's partners of the value that the initiative would bring and the need for change in the same way that it was able to convince most of its internal organization, then the driving force moving the initiative forward would be coming not only from Cisco, but also from within each partner organization leading to much stronger and closer collaborative effort to ensure successful execution. Cisco has provided its partners with information, analysis, and data to try and show them the value of the initiative. The problem is that Cisco's presentation did not convince the partners and hence did not constitute the incentive for collaboration that Cisco intended. In order to convince the partners Cisco need to speak the partner's "language", i.e. the partner's data and analysis requirements. First an understanding the amount and format of information, data, and analysis that each partner requires in a value proposition is needed. Then by tailoring the type of analysis performed, the amount and format of information shared, and the presentation to each organization, Cisco is much more likely to give a presentation that actually means something to the partner. For example, Flextronics with its thin margins will likely need rigorous analysis and data, preferably in absolute form, around the potential risks with the project including well developed risk mitigation plans early on. A step beyond speaking the partner's language is to gain the partners trust. By for example involving the partner in the data collection and analysis performed, the "not invented here" syndrome can be minimized. Involvement can take many forms and can be initiated by simply asking the partner what type of analysis they would like to see or if they have any suggestion for how to approach the analysis. In addition, it is important to present the material to the right people. Cisco needs to understand how decisions are made in each organization and convince the appropriate and powerful people within each organization. Compared to Cisco, Flextronics is a much more hierarchical and experience based organization. Seniority, age, and company longevity builds credibility at Flextronics. Hence, Cisco should focus effort on convincing the organizational veterans within Flextronics and work with them to present the ideas to the rest of the organization. Finally, it will also help if Cisco is able to provide a link between the project and their partner's strategy and vision. At the end of the day each participant's interest is to ensure that their respective organization is successful and that they themselves are providing value to their organization. Collaboration will be the healthiest when everyone involved with the initiative is convinced that the initiative will provide value for his or her organization.

6 Characterization using Literature Framework

This section uses the framework and tools presented by Hansen and Nohria[36] to identify and analyze inter-company collaboration barriers present between Cisco and Flextronics in the Lean 2.0 Demand Pull Initiative. As discussed in the literature review, Hansen and Nohria's framework and helps identify the mix and extent of collaboration barriers present in an organizational unit and links the inter-unit collaboration barriers with the managerial actions that can reduce those barriers. Hansen and Nohria's framework was chosen as it allows benchmarking against the 107 companies that were part of their study. Benchmarking gives an indication of the overall level of collaboration within the organizational unit, and it also enables evaluation of the level of implication each barrier presents to the organizational unit. In this study the methodology is slightly modified to analyze inter-company collaboration as opposed to inter-unit collaboration. The modified version of Hansen and Nohria's survey was taken by Demand Pull team members from both Cisco and Flextronics. The survey results were then used to identify inter-company collaboration barriers present in the Demand Pull team and recommendations for how to reduce the identified barriers were made. The methodology resulted in the following key findings:

- In general Cisco and Flextronics Lean 2.0 Demand Pull team members feel very positive about their collaboration with each other.
- Cisco team members feel more positive about collaboration within the Demand Pull initiative than Flextronics team members do.
- Cisco team members feel the most positive about their Cisco and Flextronics teammates' willingness to help while Flextronics team members feel the most positive about their Cisco and Flextronics teammates' ability to work together to transfer tacit knowledge.
- Cisco and Flextronics team members agree that the most significant barrier to inter-company collaboration between Cisco and Flextronics within the Demand Pull initiative is the inability to seek and find subject matter experts, documents, and information within and across the two companies.

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[36] Hansen, M. T., Nohria, N. (2004), *How to build collaborative advantage,* MIT Sloan Management review, Fall 2004

To help team members find experts, documents, and information the Lean 2.0 Demand Pull leadership team should focus on creating and supporting formal and informal lateral cross unit mechanisms. Examples of such mechanisms include building networks of people that can act as connectors between the companies, identifying and utilizing people within each company who already have built up an extensive network and can act as connectors, and making powerful collaborative technologies available to help people connect and collaborate virtually. The following sections describe the survey information, survey results, and recommendations in more detail.

6.1 Survey Details

The survey consists of 12 statements representing various collaborative barriers. The statements were divided into four categories covering the four collaboration barriers identified by Hansen and Nohria (for further information on the collaboration barriers identified by Hansen and Nohria see Table 2 in the Literature Review chapter). In order to use Hansen and Nohria's framework their survey was slightly modified such that the survey questions apply to inter-company collaboration rather than inter-unit collaboration. See Appendix 2 for Hansen and Nohria's original survey questions. For each statement the respondent was asked to rate to what extent the barrier presented in the statement was present among their Cisco Lean 2.0 Demand Pull team members and among their Flextronics Lean 2.0 Demand Pull team members. Hence each respondent scored both his or hers Cisco and Flextronics Lean 2.0 Demand Pull team members. Each of the four barrier categories as well as the 12 survey statements are listed below:

First Barrier: Unwillingness to seek input and learn from others, or the "not invented here problem"

1. Even when they need help, team members are not willing to seek input from outside their company or organizational unit. Assess your Cisco and Flextronics team members from 1 (not at all) to 100 (to a large extent)
2. When faced with problems, team members strive to solve them by themselves without asking for help from other team members or outsiders. Assess your Cisco and Flextronics team members from 1 (not at all) to 100 (to a large extent)

3. There is a prevailing attitude in the team that people ought to fix their own problems and not rely on help from others outside the team. Assess your Cisco and Flextronics team members from 1 (not at all) to 100 (to a large extent)

Second Barrier: Inability to seek and find expertise, or the "needle in a haystack problem"

4. Team members often complain about the difficulty they have locating people who possess the information and expertise they need. Assess your Cisco and Flextronics team members from 1 (not at all) to 100 (to a large extent)
5. Experts in the company are very difficult to locate. Assess difficulty of locating Cisco and Flextronics experts from 1 (not at all) to 100 (to a large extent)
6. Team members have great difficulty finding the documents and information they need in company databases and knowledge-management systems. Assess the difficulty of finding Cisco and Flextronics documents and information from 1 (not at all) to 100 (to a large extent)

Third Barrier: Unwillingness to help, or the "hoarding of expertise problem"

7. Team members do not share their expertise and information for fear of becoming less valuable. Assess your Cisco and Flextronics team members from 1 (not at all) to 100 (to a large extent)
8. Team members keep their expertise and information to themselves and do not want to share it across companies or organizational units. Assess your Cisco and Flextronics team members from 1 (not at all) to 100 (to a large extent)
9. Team members seldom return phone calls and e-mails when asked for help. Assess your Cisco and Flextronics team members from 1 (not at all) to 100 (to a large extent)

Fourth Barrier: Inability to work together and transfer knowledge, or the "stranger problem"

10. Team members have not learned how to work together effectively across company or organizational units to transfer tacit knowledge. Assess your Cisco and Flextronics team members from 1 (not at all) to 100 (to a large extent)
11. Team members from different companies or organizational units are not used to working together and find it hard to do so. Assess your Cisco and Flextronics team members from 1 (not at all) to 100 (to a large extent)

12. Team members find it difficult to work across units to transfer complex technologies and best practices. Assess your Cisco and Flextronics team members from 1 (not at all) to 100 (to a large extent).

The survey presented above was taken by a group of eight people involved with Cicos's Lean 2.0 Demand Pull initiative; four Flextronics employees and four Cisco employees. Even though this may seem like a small sample size, it is indicative of the behavior within the Demand Pull team since only people closely involved with the initiative were asked to take the survey and a survey response rate of over 50% was achieved. All survey takers were anonymous but were asked to identify which company they belonged to. The scores for each statement were analyzed in several ways. First the scores from the four Cisco respondents, the four Flextronics respondents, as well as all eight respondents were averaged separately for Cisco team members, Flextronics team members, and all team members (Cisco and Flextronics team members combined). These average scores for the three statements within each category were then summed up and compared against the 107 company benchmark table provided in Hansen and Nohria's paper. Hansen and Nohria's table divided the summed up scores for each barrier category into four quartiles. Survey scores falling within the range of points in the lowest quartile indicates that the barrier does not pose a problem for the team. Reaching a score within the second quartile range suggests the barrier might cause some problems. Reaching the third quartile indicates the barrier is a problem, and reaching the fourth quartile indicates the barrier is a big problem. Each respondent's individual scores in each category were also compared to the benchmark table and the number of respondents in each benchmark quartile was counted. The next section provides the results of the survey.

6.2 Survey Results

This section presents the survey results and how they compared to Hansen and Nohria's 107 company benchmarking table quartiles. Table 9 below shows a matrix presentation of the Lean 2.0 Demand Pull mean survey scores for each of the four collaborative barriers and the implication associated with the survey results. For each collaborative barrier the data is presented in a three by three matrix; the survey respondents are divided into three groups (Cisco respondents, Flextronics respondents, and Cisco and Flextronics respondents combined) and these three groups of respondents are listed vertically on the left side of the matrix. Similarly, the Lean 2.0 Demand Pull teammates who are being evaluated by the respondents have been divided into three groups (Cisco teammates, Flextronics teammates, and Cisco and Flextronics teammates combined) and these three groups are listed horizontally across the top of the matrix. The colored cells presents the mean survey score that each group of survey respondents gave each group of Cisco Lean 2.0 Demand Pull team members and compares the mean score to Hansen and Nohria's benchmarking data. Each cell presents the Hansen and Nohria benchmarking quartile within which the Lean 2.0 Demand Pull mean survey scores fell within (i.e. 1st Quartile, 2nd Quartile, 3rd Quartile, or 4th Quartile). The associated benchmarking quartile upper bound and lower bound are presented in the parenthesis. The Lean 2.0 Demand Pull survey mean score is presented in the parenthesis (in bold) to allow comparison with the benchmarking quartile upper and lower bound. The table cells also indicate the implication associated with that quartile (i.e. barrier is not a problem, barrier might cause some problems, barrier is a problem, or barrier is a big problem). Finally, the table cells are colored to allow for quick identification of survey results. Cells with scores indicating that the barrier does not present a problem are colored green, cells with scores indicating that the barrier may cause some problems are colored yellow, and cells with scores indicating that the barrier presents a problem are colored orange. There are only three colors since none of the mean scores fell in the highest quartile that corresponds to benchmarking results where the barrier presents a big problem.

First Collaborative Barrier: Unwillingness to seek input and learn from others			
	Evaluation of Cisco Demand Pull Team Members	**Evaluation of Flextronics Demand Pull Team members**	**Evaluation of Cisco & Flextronics Demand Pull Team members combined**
Cisco Survey Respondents	1st Quartile (3-**69**-105) Barrier is not a problem	1st Quartile (3-**97**-105) Barrier is not a problem	1st Quartile (3-**83**-105) Barrier is not a problem
Flextronics Survey Respondents	2nd Quartile (106-**150**-160) Barrier might cause some problems	2nd Quartile (106-**116**-160) Barrier might cause some problems	2nd Quartile (106-**133**-160) Barrier might cause some problems
Cisco & Flextronics Survey Respondents	2nd Quartile (106-**111**-160) Barrier might cause some problems	2nd Quartile (106-**108**-160) Barrier might cause some problems	2nd Quartile (106-**109**-160) Barrier might cause some problems

Second Collaborative Barrier: Inability to seek and find expertise			
	Evaluation of Cisco Demand Pull Team Members	**Evaluation of Flextronics Demand Pull Team members**	**Evaluation of Cisco & Flextronics Demand Pull Team members combined**
Cisco Survey Respondents	1st Quartile (3-**87**-90) Barrier is not a problem	2nd Quartile (91-**118**-135) Barrier might cause some problems	2nd Quartile (91-**102**-135) Barrier might cause some problems
Flextronics Survey Respondents	3rd Quartile (136-**142**-180) Barrier is a problem	2nd Quartile (91-**135**-135) Barrier might cause some problems	3rd Quartile (136-**138**-180) Barrier is a problem
Cisco & Flextronics Survey Respondents	2nd Quartile (91-**114**-135) Barrier might cause some problems	2nd Quartile (91-**128**-135) Barrier might cause some problems	2nd Quartile (91-**121**-135) Barrier might cause some problems

Third Collaborative Barrier: Unwillingness to help			
	Evaluation of Cisco Demand Pull Team Members	**Evaluation of Flextronics Demand Pull Team members**	**Evaluation of Cisco & Flextronics Demand Pull Team members combined**
Cisco Survey Respondents	1st Quartile (3-**17**-60) Barrier is not a problem	1st Quartile (3-**11**-60) Barrier is not a problem	1st Quartile (3-**14**-60) Barrier is not a problem
Flextronics Survey Respondents	2nd Quartile (61-**64**-100) Barrier might cause some problems	2nd Quartile (61-**66**-100) Barrier might cause some problems	2nd Quartile (61-**65**-100) Barrier might cause some problems
Cisco & Flextronics Survey Respondents	1st Quartile (3-**40**-60) Barrier is not a problem	1st Quartile (3-**39**-60) Barrier is not a problem	1st Quartile (3-**39**-60) Barrier is not a problem

Fourth Collaborative Barrier: Inability to work together and transfer knowledge			
	Evaluation of Cisco Demand Pull Team Members	**Evaluation of Flextronics Demand Pull Team members**	**Evaluation of Cisco & Flextronics Demand Pull Team members combined**
Cisco Survey Respondents	1st Quartile (3-**80**-110) Barrier is not a problem	2nd Quartile (111-**138**-168) Barrier might cause some problems	1st Quartile (3-**109**-110) Barrier is not a problem
Flextronics Survey Respondents	2nd Quartile (111-**150**-168) Barrier might cause some problems	1st Quartile (3-**78**-110) Barrier is not a problem	2nd Quartile (111-**120**-168) Barrier might cause some problems
Cisco & Flextronics Survey Respondents	2nd Quartile (111-**115**-168) Barrier might cause some problems	1st Quartile (3-**108**-110) Barrier is not a problem	2nd Quartile (111-**111**-168) Barrier might cause some problems

Table 9: How survey respondents scored their Cisco and Flextronics team members. Mean survey scores and comparison to quartiles of Hansen and Nohria's 107 benchmarked companies (benchmark quartile lower bound - **survey mean score** - benchmark quartile upper bound)

Table 9 shows that the mean scores were comparatively low compared to the 107 companies benchmarked in Hansen and Nohria's study. For example, the third quartile of the benchmark data was only reached in two of the 36 cells in table 9 and the survey mean scores never reached the fourth quartile of the benchmark data. Figures 6 and 7 show the spread of individual survey responses by tracking which benchmark quartile each individual Lean 2.0 Demand Pull survey respondents scores fell within. The count of individual respondents in each benchmark quartile is presented for each of the four barrier categories. The charts are separated by Cisco survey respondents (left) and Flextronics survey respondents (right) and within each chart the results show how Cisco team members (light grey) and Flextronics team members (dark grey) were scored by that group of respondents. For example, the top left chart in Figure 6 shows that all four Cisco respondents rated their Cisco Demand Pull team mates very willing to seek input and learn from others. When the same respondents rated their Flextronics Demand Pull team mates, only three out of four Cisco respondents rated their Flextronics team mates very willing to seek input and learn from others, while one Cisco respondent rated their Flextronics Demand Pull team mates as very unwilling to seek input and learn from others. Figure 8 shows the same charts for all (Cisco and Flextronics) respondents combined.

Cisco Survey Respondents | **Flextronics Survey Respondents**

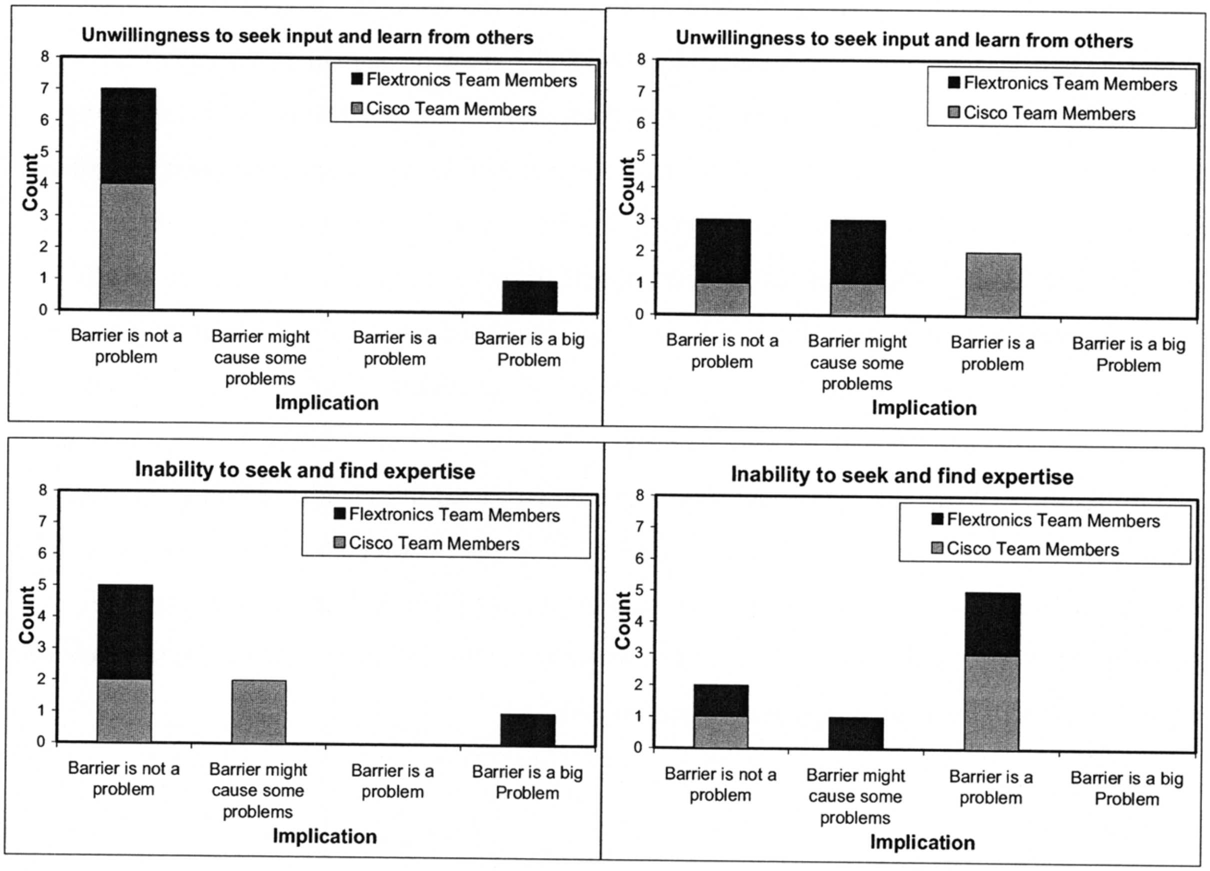

Figure 6: Count of individual respondents' survey scores for the first two barrier categories

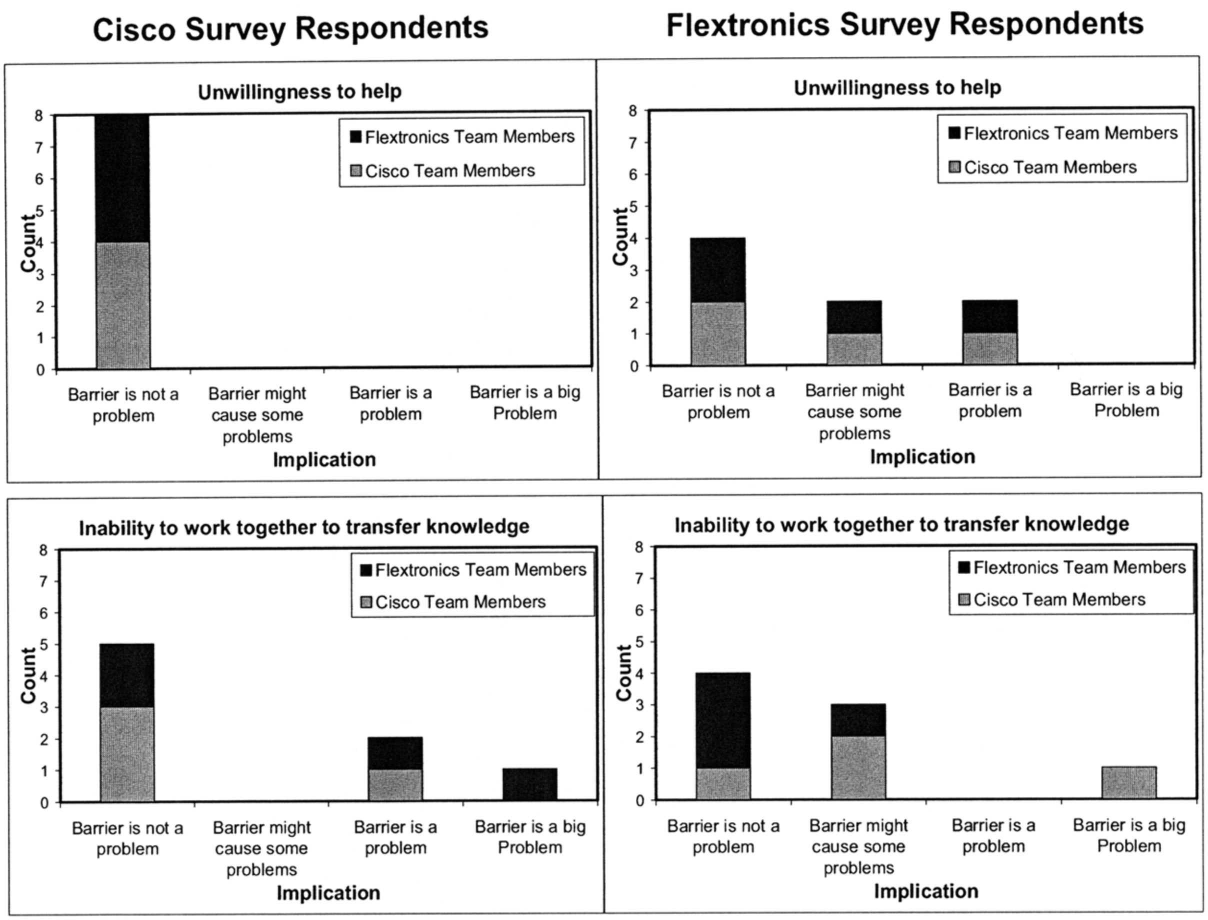

Figure 7: Count of individual respondents' survey scores for the last two barrier categories

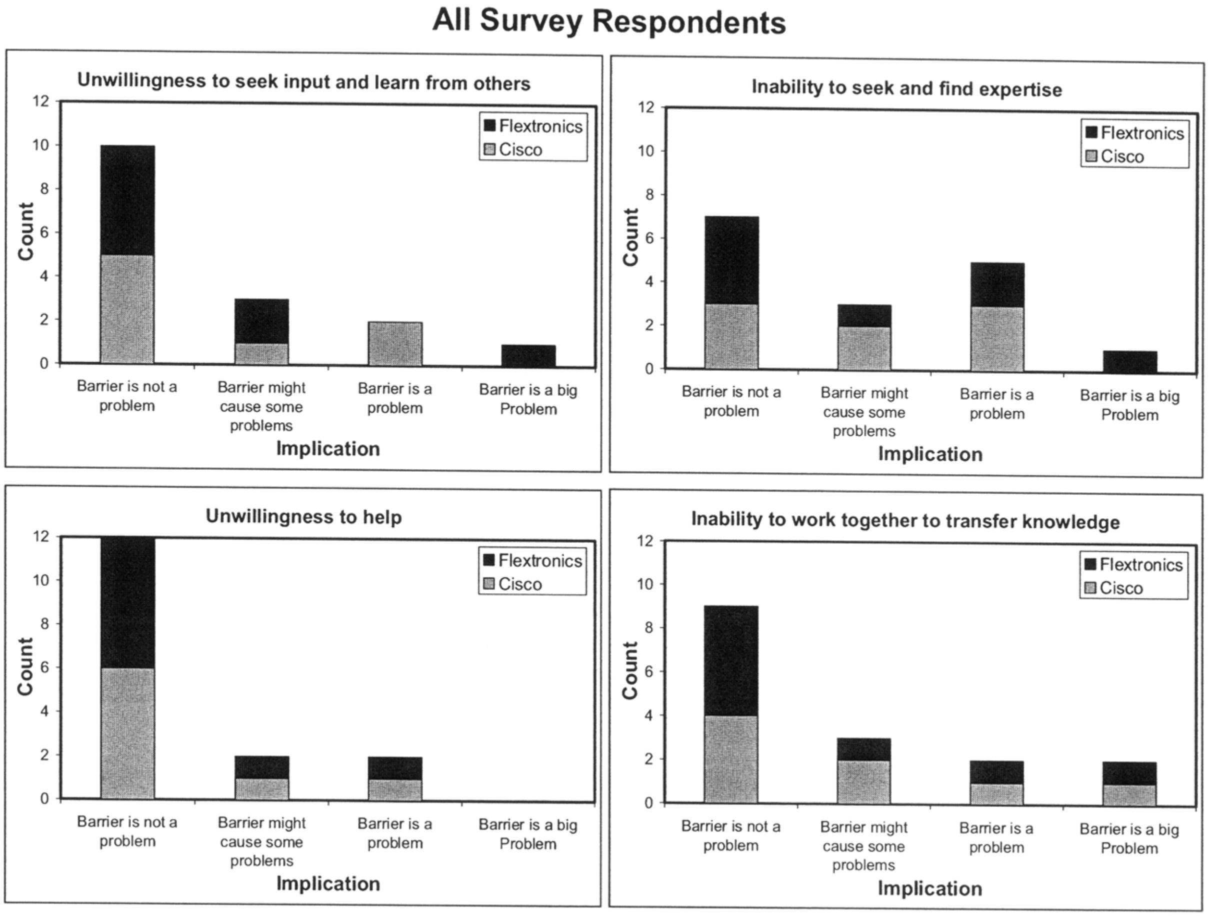

Figure 8: Count of all respondents' individual survey scores for all four barrier categories

The results presented in Table 9 and Figures 6, 7, and 8 indicate that overall Cisco and Flextronics team members feel positive about collaboration within the Lean 2.0 Demand Pull team. The survey does expose some interesting dynamics within the Demand Pull team. For example, when comparing Cisco respondents' scores with Flextronics respondents' scores in general it is found that in general Cisco respondents gave more positive scores to both their Cisco and Flextronics team mates compared to the scores given by the Flextronics respondents. This indicates that Cisco respondents feel more positive about collaboration within the Demand Pull team compared to the Flextronics respondents.

For Cisco respondents "willingness to help each other" is rated as the healthiest category. They feel their team members from both Cisco and Flextronics are good at returning phone calls and e-mails when asked for help, are willing to share information and knowledge, and do not fear becoming less valuable by sharing the information they have. Even through there are collaboration barriers present, the people within the team, and in particular Cisco team members, feel that their Cisco and Flextronics team mates are willing to help each other to overcome those barriers. Flextronics respondents felt the most positive about their internal Flextronics team members' ability to work together and transfer knowledge.

Another interesting finding is that, in general, collaboration barriers are perceived as less present for team members who belong to the respondent's own company. Cisco respondents rate their Cisco team members as having fewer problems associated with collaboration barriers compared to their Flextronics team members. Similarly, Flextronics respondents rate their Flextronics team members as having fewer problems associated with collaboration barriers compared to their Cisco team members. Interestingly, for both Cisco and Flextronics respondents the one exception is in the "unwillingness to help" category. In this category the scores are reversed and Cisco respondents score their Flextronics team members as more willing to help compared to their internal Cisco team members. Likewise, Flextronics respondents score their Cisco team members as more willing to help compared to their internal Flextronics team members.

Both Cisco and Flextronics respondents agree that the most problematic barrier to collaboration within the Lean 2.0 Demand Pull team is "inability to seek and find expertise". Flextronics respondents feel stronger than Cisco respondents that inability to seek and find expertise is a problem within both Flextronics and Cisco. Digging into the data deeper, one finds that it is easy for Cisco employees to locate Cisco experts but difficult for them to locate Flextronics experts. While Flextronics employees have a difficult time locating experts in both companies, although slightly easier within their own company compared to within Cisco. Finding documents and information in company databases and knowledge management systems rates as the biggest problem, and naturally it was more difficult to find information in the other company's databases and knowledge management systems.

Finally, The survey shows that respondents in both companies feel that inability to work together across company boundaries and lack of knowledge transfer across company boundaries cause some problems within the Lean Demand Pull team. Interestingly, both Cisco and Flextronics respondents feel that the barriers are more applicable to their external team members than their internal team members. They feel team members from the other company have not yet learned how to work together effectively across company or organizational units and have a difficult time transferring complex technologies and best practices across units.

In conclusion, the survey results indicate that in general Flextronics respondents feel positive about collaboration with both their Cisco and Flextronics Demand Pull team members, and Cisco respondents feel even more positive about Demand Pull collaboration. Cisco respondents feel the most positive about their Cisco and Flextronics teammate's willingness to help, seek input from, and learn from others, while Flextronics respondents feel the most positive about their team members ability to work together to transfer tacit knowledge. Based on the survey the biggest problem to Cisco and Flextronics inter-company collaboration within the Demand Pull initiative is the inability to seek and find experts as well as documents and information within and across companies. In particular it is found that Flextronics experts and documents are difficult to find for everyone, while Cisco experts and documents are easier to find for Cisco employees compared to Flextronics employees.

6.3 Recommendations

Hansen and Nohria recommend using various management levers to remove the collaborative barriers present within organizations. This section will present the levers proposed to remove the collaborative barriers identified through the survey and discuss their appropriateness within the Lean 2.0 Demand Pull initiative.

As stated in Section 6.2 the biggest problem to Cisco and Flextronics inter-company collaboration is the inability to seek and find experts as well as documents and information within and across companies. To remove this collaborative barrier Hansen and Nohria propose focusing on creating lateral cross unit mechanisms, both formal and informal[37]. Informal cross unit mechanisms can for example be professional networks or people that act as connectors between the companies. The Lean 2.0 Demand Pull steering committee is already making an effort to establish and cultivate a strong network within the initiative. For example, Cisco has arranged two or three Lean summits where a team of people responsible for implementing Lean 2.0 demand pull from each contract manufacturer meet with the Cisco design team for a day or

[37] Hansen, M. T., Nohria, N. (2004), *How to build collaborative advantage,* MIT Sloan Management review, Fall 2004

two to brainstorm, reach consensus, and move forward on various agenda items related to the initiative. Also part of the summit is a dinner where the team members have an opportunity to get to know each other and form stronger bonds. The summit serves as way for people to meet, network and form bonds that can aid in future knowledge sharing and collaboration.

Another informal cross unit mechanism is identifying and utilizing the people within each company who can act as connectors[38]. Connectors are people who know where experts, ideas, and information resides in a company and can relay that information to the people that need it and connect people who do not know each other. These people have often been with a company for a longer period and have had the time to build up a large personal network within the company. For the demand pull initiative there is need to find and utilize connectors that have worked closely with Cisco and Flextronics as well as connectors that are long-tenured within each company. Especially since both companies have grown mainly through acquisitions, it will be even more difficult to find connectors that have extensive networks across the entire company.

An example of formal cross unit mechanism is establishing formal teams and committees that include members from both companies. The Lean 2.0 Demand Pull steering committee has established such formal cross-company teams and committees and they meet regularly over the phone. These teams and committees also help improve the cross unit linking mechanisms and improve future collaboration.

The Lean 2.0 Demand Pull team is a complex mix of people from five different companies all across the world that faces a complex implementation problem. This team can benefit from using information systems such as such as knowledge management databases and benchmark systems as formal cross-unit linking mechanisms. As demand pull is implemented at Cisco's manufacturing partner facilities across the world it will be very important to make it easy for the people who will actually use the system to easily search for information and documents as well as get in touch with the experts that designed the system. Currently Cisco has created a Lean 2.0 SharePoint site that hosts all the documents and presentations related to the Lean 2.0 initiatives, including information for the Demand Pull track. The SharePoint site also has contact information to the members of the team. I recommend enhancing this SharePoint site to make it

[38] Hansen, M. T., Nohria, N. (2004), *How to build collaborative advantage,* MIT Sloan Management review, Fall 2004

more user-friendly. For example, list more detailed information on each team members such as their job title responsibilities, as well as their work history and any subject where they can be considered experts. I also suggest complementing the SharePoint with web3.0 technologies to help people connect and collaborate virtually. For example the equivalent of a Lean 2.0 Demand Pull "Facebook" and a Demand Pull "Wikipedia" could be set up to allow people to find each other, connect with each other, and jointly create content and share information with each other. Finally, I recommend the Lean 2.0 Demand Pull team to explore new collaboration technologies such as the one being developed at MIT called the collaboratorium model. [39] This model uses "a combination of internet-mediated interaction, collectively generated idea repositories, computer simulation, and explicit representation of argumentation to help large, diverse, and geographically-dispersed groups systematically explore, evaluate, and come to decisions concerning systemic challenges". However, before such powerful collaboration technologies can be used successfully there has to exist an underlying drive and will of the people involved to collaborate with each other. The survey showed that the willingness to help is there among the Demand Pull Team members. It is important for leadership to nurture that willingness and motivate people to continue to seek and provide help to each other. Leaders can do this by role modeling and rewarding the desired behavior and focus not only on what was accomplished but more on how something was accomplished. It is also important that the leaders within both companies develop and articulate unifying goals that motivate people to work across companies to realize shared goals.

[39] Klein, M, Malone, T. Sterman, J. Quadir, I (2006). *The Climate Collaboratorium: Harnessing Collective Intelligence to Address Climate Change Issues,* Massachusetts Institute of Technology, June 22, 2006 http://cci.mit.edu/collaboratorium.pdf

7 Collaboration Pain Point Deep Dive

In addition to studying how Cisco and Flextronics collaborate within the Lean 2.0 Demand Pull initiative, this work also attempts to aid the Lean 2.0 Demand Pull implementation effort by addressing a particular implementation barrier: hesitation around the value of the initiative and around the potential risks and benefits of implementing a Demand Pull methodology. This hesitation was felt by some of the Demand Pull team members on both Cisco and Flextronics side, but was articulated mostly by people within Flextronics. As one Flextronics team member stated: "We are just not comfortable with MPS Propagation and the ROP planning initiative". When asked about the biggest worry about the initiative, a Cisco manager stated "We are not sure we are doing the right thing, we don't know how difficult it will be to implement". Cisco has recognized that this hesitation constitutes a barrier and has addressed it in various ways. For example, Cisco built a model showing the reduction of forecast error as the forecast signal propagates up the supply chain under the proposed system. This model and a presentation that covered model results for a variety of possible forecast error and bias combinations were shared with the partners. Cisco also captured feedback and questions in the weekly phone meetings. They arranged face-to-face partner summit meetings with the intent to inform, discuss, and reach agreement around the requirements of the initiative and the replenishment rules and processes to be followed. As the initiative went along the face-to-face meetings became increasingly more effective and provided a great avenue in which consensus could be reached and a progress made. These attempts, for various reasons, did still not convince everyone that the chosen methodology was valuable. A Cisco manager expressed: "We wish there could be more face-to-face interaction with the partners to resolve grey areas and clarify issues". But others felt that there was a need to move on even if there was disagreement and instead focus on hitting the deadlines. Some team members were starting to get frustrated dealing with questions from people that were not convinced and felt it took too much time in meetings and slowed down progress. One Cisco employee stated: "We wish the partners would just stop debating, and say yes so we can move forward with implementation".

7.1 Project Goal and Approach

In an attempted to overcome the hesitation barrier presented above, a project was started with the intent to provide an analysis based on actual historical data to highlight the potential benefits and risks of implementing a demand pull methodology. The goal was to use a Dynamic Simulation technology provided by Simflex[40] and simulate actual historical data from Cisco and Flextronics in order to identify and quantify the proposed methodology's impact on financial, inventory, and other supply chain metrics. The simulation was first run using the previous push replenishment methodology used at Flextronics to establish a current state baseline. Then the simulation was run using the proposed demand pull methodology to explore the future state. Two different types of products were simulated to explore sensitivity to demand volume and variability. The first product was a high demand, low variability assembly, and the second product was a low demand, high variability assembly. The simulation used the actual forecast or Master Production Schedule (MPS) signal sent from Cisco to Flextronics' plant in Austin, TX, as well as the actual outgoing orders for the two assemblies over a 6 month period. Figure 9 shows the approach taken for the push simulation.

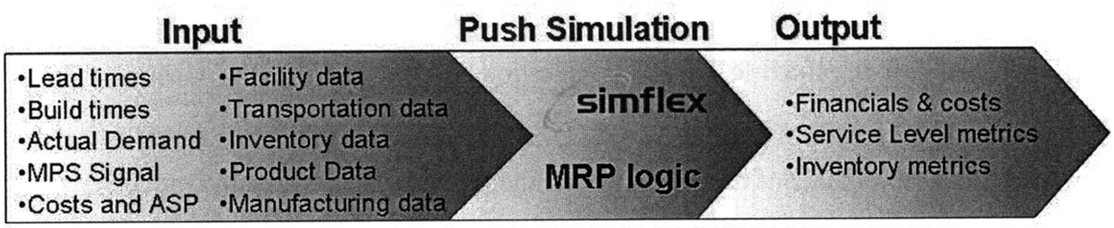

Figure 9: Push Simulation Approach

Actual demand, manufacturing, facility, transportation, inventory, product, and cost data was collected and used to build the dynamic simulation scenarios. The push simulation scenario was built using the push replenishment logic available in Simflex. As output the dynamic simulation delivered numerous financial, cost, service level, and inventory metrics. Figure 10 shows the approach taken for the demand pull simulation.

[40] SimFlex is an optimization and simulation software suite geared towards value chain solutions. See Appendix 1 for more information on available Simflex Solution engines. The SimFlex Group is an independent business unit of Flextronics, http://www.simflexgroup.com/

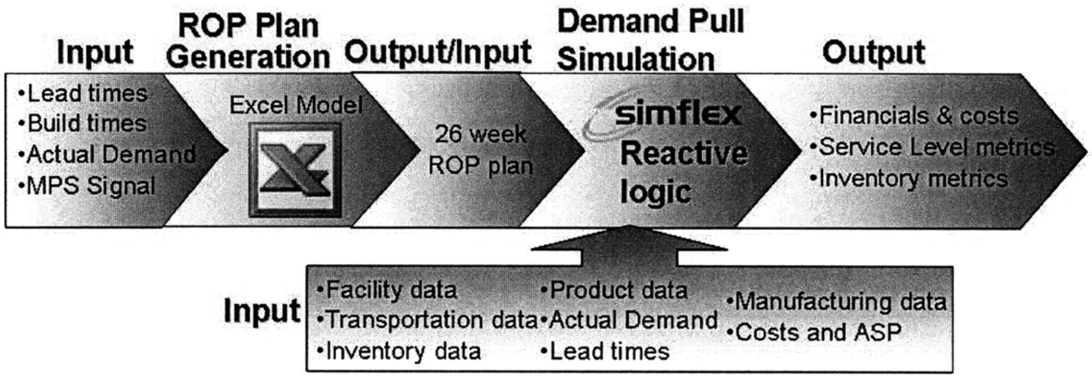

Figure 10: Demand Pull Simulation Approach

The Simflex simulation software did not have the logic built in to simulate MPS propagation. MPS propagation is an integral part of the Demand Pull replenishment methodology. Without it, demand pull would be equivalent to a conventional pull replenishment system. MPS propagation uses a forecast to plan the upstream node's re-order-point (ROP) levels and predicts supply requirements based on the planned ROP levels. It then propagates those supply requirements upstream the supply chain as input to the next nodes planned ROP levels and predicts that nodes ROP levels and so on. Programming MPS propagation logic into Simflex is possible, but is rather complex and time consuming and since this type of logic is not used widely through industry Simflex could not set aside resources for programming. Instead an existing Cisco Excel model[41] was modified to generate an ROP plan that could then be used as input into Simflex. The Excel model took the six month forecast, lead times, and build times as input and generated ROP level plans for the supply chain nodes. The excel model then went week by week for 26 weeks and took as input the actual weekly orders and the updated forecast for each week, it recalculated the requirements, and as output generated a weekly ROP[42] plan for all nodes. The output (i.e. the 26 week by week ROP plan) from the Excel model was then used as input into Simflex combined with the other inputs (actual demand, manufacturing, facility, transportation, inventory, product, and cost data). This time Simflex was set up to run using the built in pull

[41] Thanks to Mert Sanver at Cisco for providing the model

[42] See Appendix 3 for a description of methodology used to calculate weekly ROP levels

replenishment logic instead of push replenishment logic. As output Simflex generated the same format of financial, cost, service level, and inventory metrics as the push simulation and the outputs were then compared to determine which methodology was beneficial or risky for different product types.

7.2 Assembly Selection

In order to find the assemblies to use in the simulation, several months' worth of sales data from Flextronics Austin, TX facility was collected. The goal was to find assemblies representing different extremes in terms of demand volume and variability to investigate how the proposed replenishment model behaved in these different situations. The collected data was plotted with the average daily demand volume on the y-axis versus the coefficient of variability of demand[43] on the x-axis. See Figure 11.

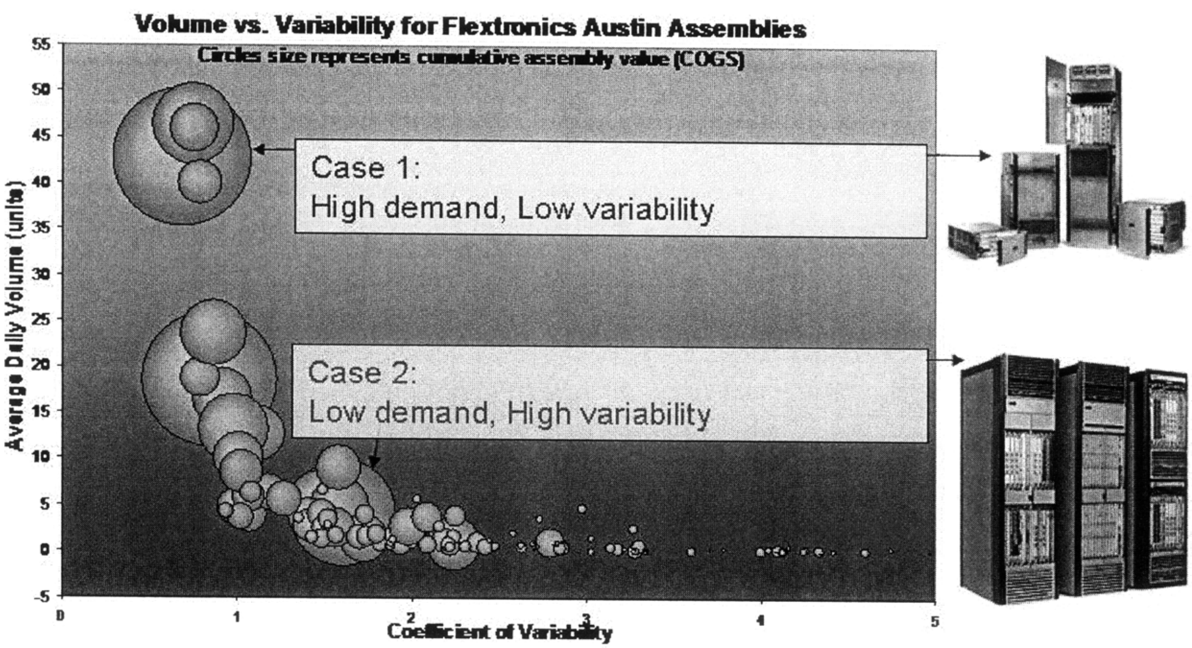

Figure 11: Assembly selection based on Demand Volume vs. Variability criteria

The circle sizes in Figure 11 represents the cumulative value of Cost of Goods Sold for each assembly. Two assemblies were chosen, both with relatively high cumulative value to ensure

[43] Coefficient of Variability (COV, CV or C_V) is the ratio of the standard deviation of a variable relative to its mean = Sample Standard Deviation / Sample Mean

data would be readily available, but each assembly representing extremes in terms of demand volume and variability. The first assembly, I will call this Assembly 1, was a high demand assembly with lower coefficient of variability. The second assembly, I will call this Assembly 2, had a much lower demand and higher coefficient of variability.

7.3 Simulation Input

MPS signal propagation, material flow, and production was simulated for a supply chain using a simplified Bill of Material (BOM). For each assembly this simplified BOM included the final assembly, a PCBA board, and two types of components, a DRAM and an IBM ASIC. In Assembly 1, there was one IBM ASIC and in Assembly 2, there were two IBM ASICs. A dummy category was set up in the simulation to include costs associated with the remainder of the parts in the actual BOM. Figure 12 depicts the facilities and companies, or nodes, that were included in the supply chain simulation.

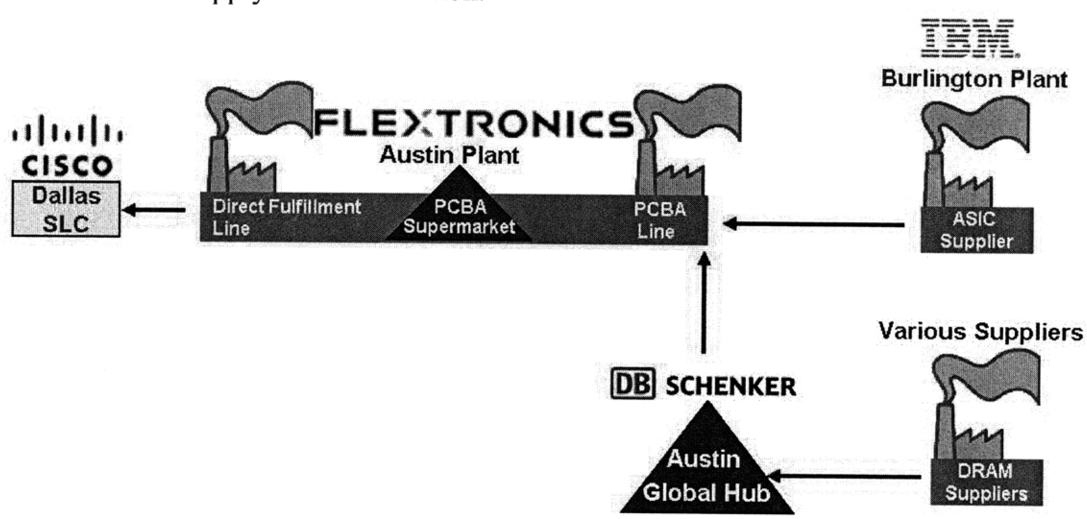

Figure 12: Simulated Supply Chain

The red arrows represent the material flow between supply chain nodes. The end customer is assumed to be Cisco's Distribution Center or Strategic Logistics Center (SLC) in Dallas. All assemblies go through this SLC on their way to the customer. Production occurs at Flextronics plant in Austin which consists of two main lines; the Direct Fulfillment Line or DF Line and the PCBA Line. The DF line is where the final assembly takes place and is where cards, power chords, fan trays, etc are built into the chassis and the final systems are tested and burnt in. DF assemblies are built and configured to order. The PCBA line, on the other hand, can build to forecast and any excess completed boards are staged in an inventory buffer called the PCBA supermarket. Some PCBA's are shipped to Flextronics DF Lines at other locations, and the Flextronics PCBA Supermarket also contains PCBA's that were built at other Flextronics sites and shipped to the Austin site. Components for the PCBA Line are either shipped from the Global Inventory Hub in Austin managed by DB Schenker, or directly from the component supplier. The DRAMs used in the simulation are sourced from various suppliers and are staged at the Inventory Hub. The ASICS are supplied directly from IBMs site in Burlington, VT.

7.3.1 Lead Times

Figure 13, figure 14, and figure 15 show the lead-times used in the Simulation. Figure 13 shows lead-times that are common between the two cases; Figure 14 and Figure 15 show lead-times for Assembly 1 and Assembly 2 respectively. Note that the lead-times for Assembly 2, the low volume high variability assembly, are up to 11 times longer compared to Assembly 1.

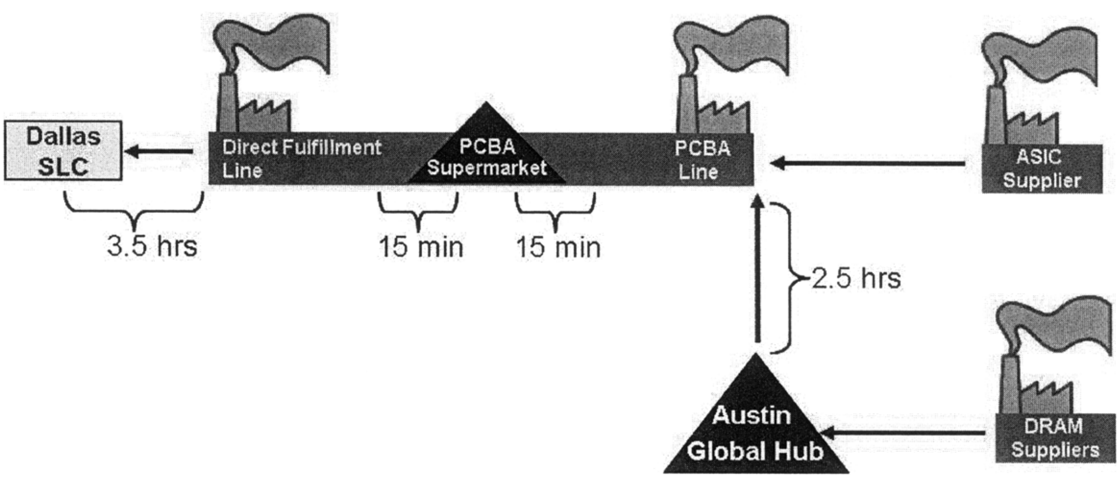

Figure 13: Lead times common between the Assemblies

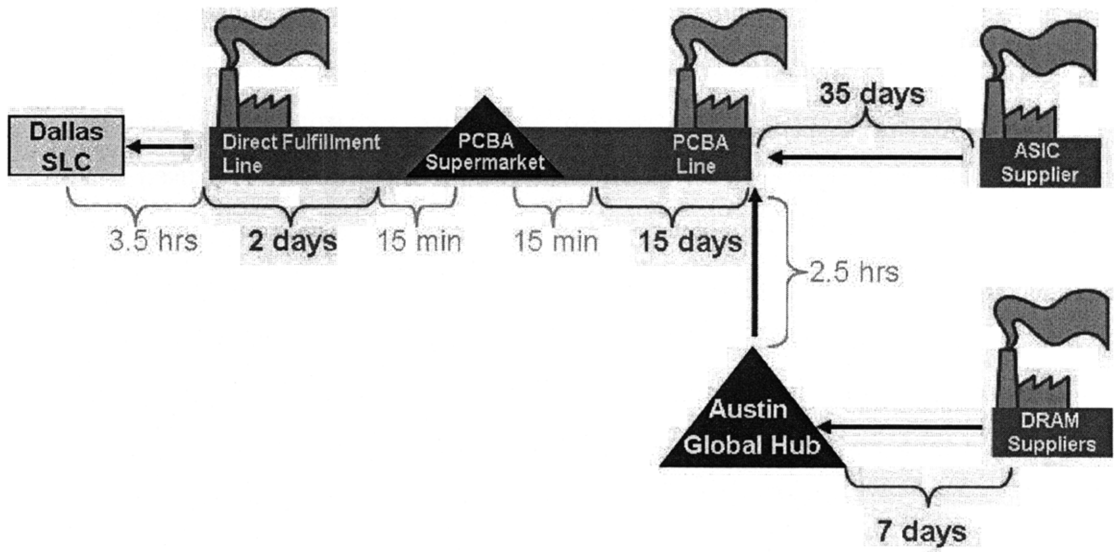

Figure 14: Lead times for Assembly 1, High Volume Low Variability Assembly

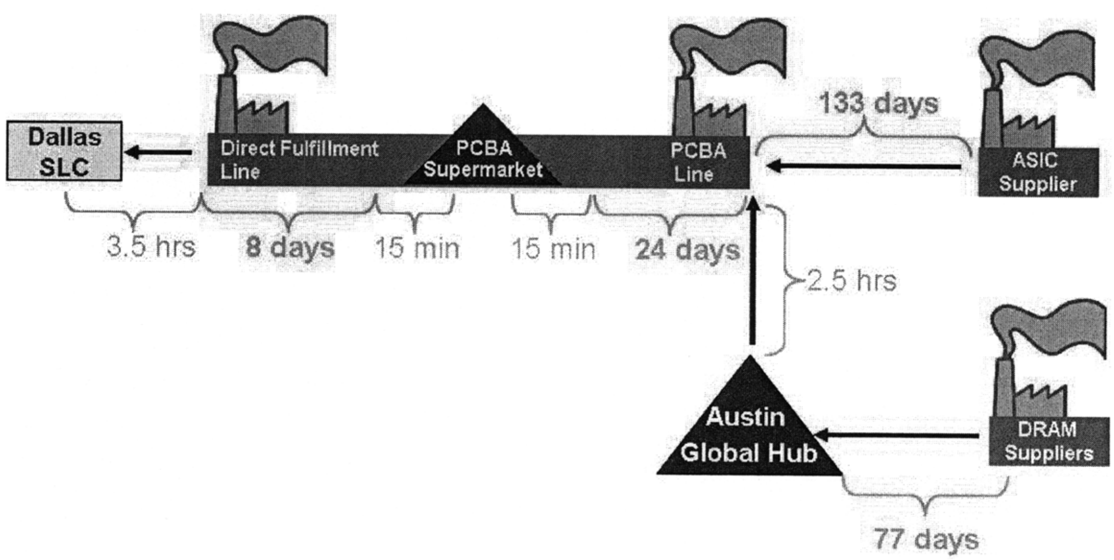

Figure 15: Lead times for Assembly 2, Low Volume High Variability Assembly

7.3.2 Replenishment Logic

Figure 16 and figure 17 outline the different replenishment logics simulated; the push logic and the demand pull logic. Just as in the previous figures, the thin red arrows represent material flow. The white arrow with red border represents the customer order signal coming into Cisco. The white arrows with blue borders represent the Cisco MPS signal and Flextronics MRP material requirements signal. The MPS signal is transmitted from Cisco to Flextronics and is used as an input into Flextronics MRP system to generate the production plan and material requirements plan. The MRP material requirements signal is then propagated upstream the supply chain. As can be seen in Figure 16 the Push logic simulation bases production on a forecast and uses a MRP system to determine upstream requirements and production plans based on the forecast at the Direct Fulfillment Line. Shipments are triggered by MRP Gross Requirements, except for Finished Goods shipments from the DF Line, which are triggered by customer orders coming through Cisco's SLC. The simulation assumes that there is only one configuration for each assembly which means that the Direct Fulfillment Line is allowed to build up Finished Goods (FG) inventory from which the Cisco SLC can pull Finished Goods. In reality this is not the case since each order is built to a specific configuration, which makes it impossible to build ahead. The implication of this assumption is that, when simulating the push replenishment logic, the push-pull boundary is located at the FG inventory, while in reality it would be located at the PCBA Supermarket.

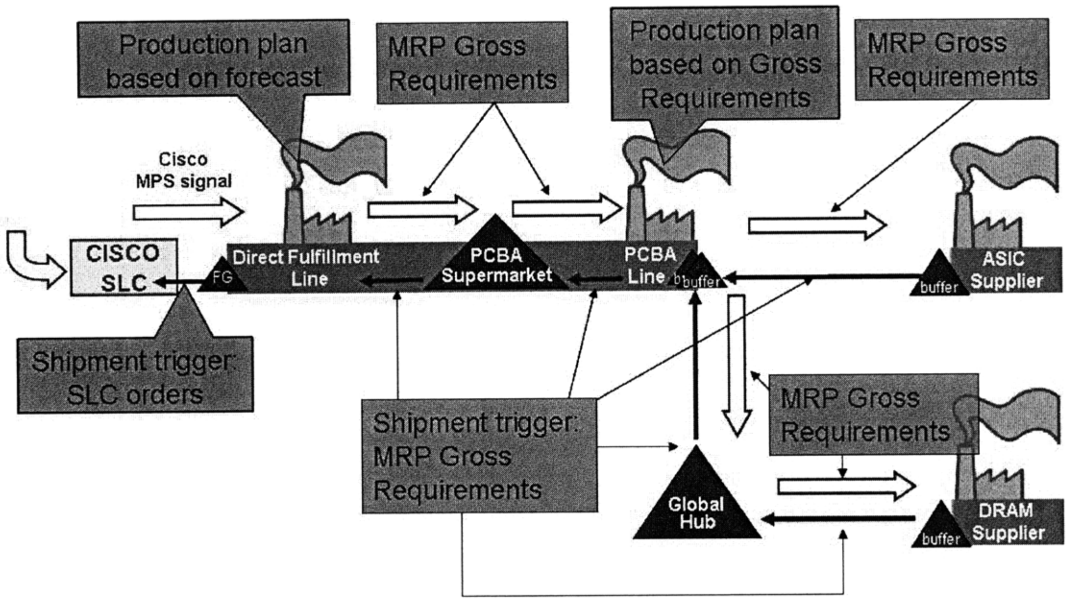

Figure 16: Push Replenishment Logic

In the demand pull simulation there will never be a FG inventory buffer since all production and material shipments are triggered through pull mechanisms instead of forecast and planned consumption signals. As Figure 17 shows, shipments are triggered by customer orders, actual consumption at the downstream node, and by buffer inventory dipping below the pre-set ROP levels.

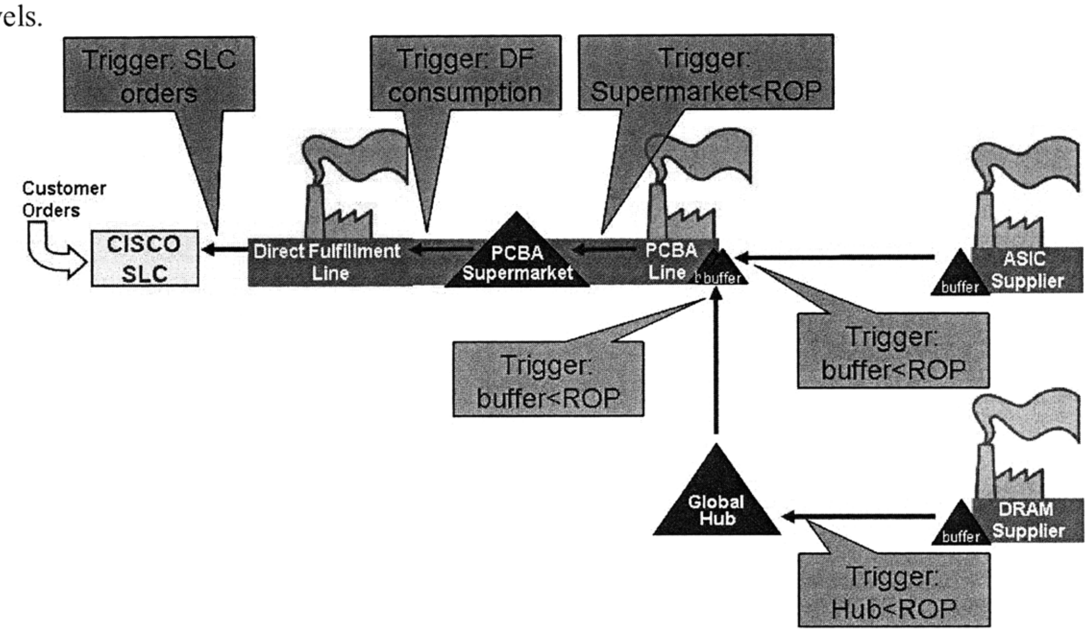

Figure 17: Demand Pull Material Triggering Logic

The ROP levels in the demand pull system are pre planned by using Cisco's MPS signal and propagating it upstream the supply chain. Figure 18 shows a simplification of the Demand Pull Planning logic. First, the MPS signal is converted to planned PCBA Supermarket consumption which serves as the basis for predicting the future PCBA supermarket ROP levels. Then based on the forecasted ROP levels and the planned consumption, a plan is generated of when the inventory will dip below the planned ROP level and trigger a production signal to the PCBA line. These forecasted Supermarket ROP triggers are then converted into planned consumption at the PCBA line, which in turn is used to predict the future ROP levels of the PCBA line component buffers, and so on.

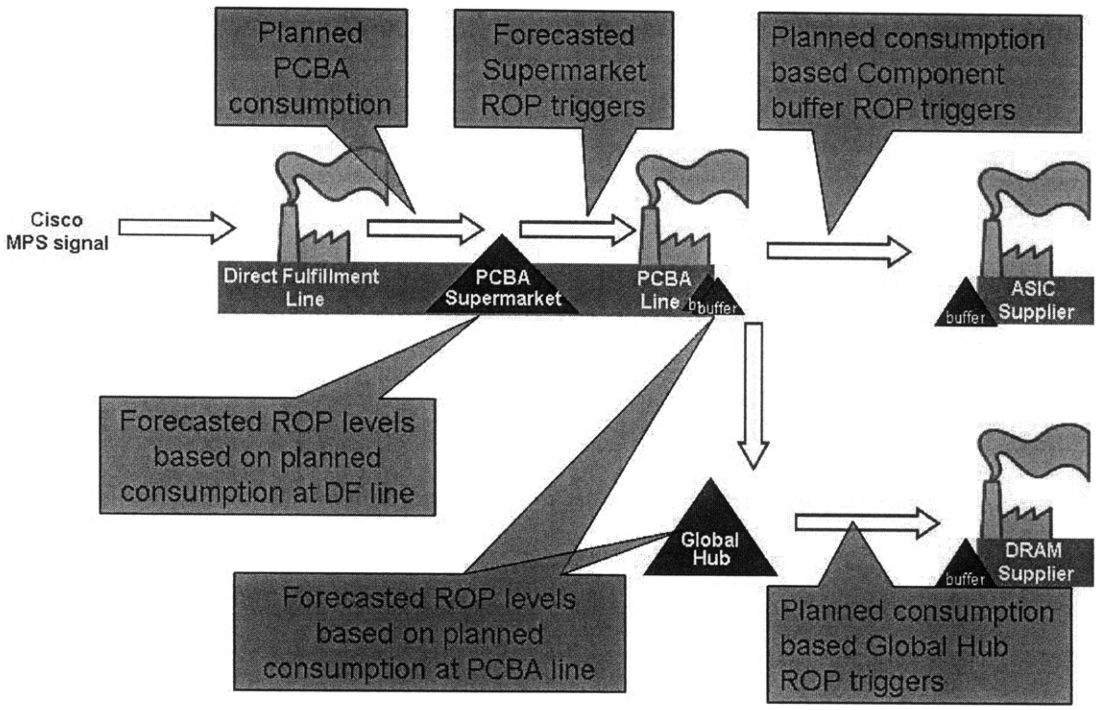

Figure 18: Demand Pull Planning Logic

7.3.3 Forecasts and Orders

Cisco converts their forecast into a Master Production Schedule (MPS) which is updated and transmitted to Flextronics every week. The actual MPS signal for the two Assemblies was used as input in the Simulation. For the Push simulation it was used to generate the MRP production plan and material requirements, and in the Demand Pull simulation the same MPS signal was used to generate the ROP plan. Figure 19 and figure 20 show a plot of the weekly MPS forecast and actual shipments over a nine month period for Assembly 1 and Assembly 2 respectively. The thin light green and yellow colored lines correspond to the weekly MPS signal for Assembly 1 and Assembly 2 respectively. The dark and thick green and orange lines correspond to the actual orders for Assembly 1 and Assembly 2 respectively. To simplify data collection for the simulation it was assumed that Flextronics shipped all incoming orders, and hence actual shipments are assumed to represent the actual incoming orders. This is believed to be a very reasonable assumption according to Cisco and Flextronics employees interviewed. The actual shipment data was used in both the push and demand pull simulation to trigger Finished Goods shipments from Flextronics to the Cisco SLC. Figure 19 and Figure 20 give the mean, standard deviation, and coefficient of variability of the weekly and daily shipments to illustrate the different characteristics of the two cases. Assembly 1 has over ten times as many shipments as Assembly 2. But the weekly standard deviation of Assembly 1 is only three to four times higher than that of Assembly 2, resulting in a much lower coefficient of variation for Assembly 1 compared to Assembly 2. These two graphs also illustrate the bias, error, and volatility of the forecasts and how it relates to the actual shipments.

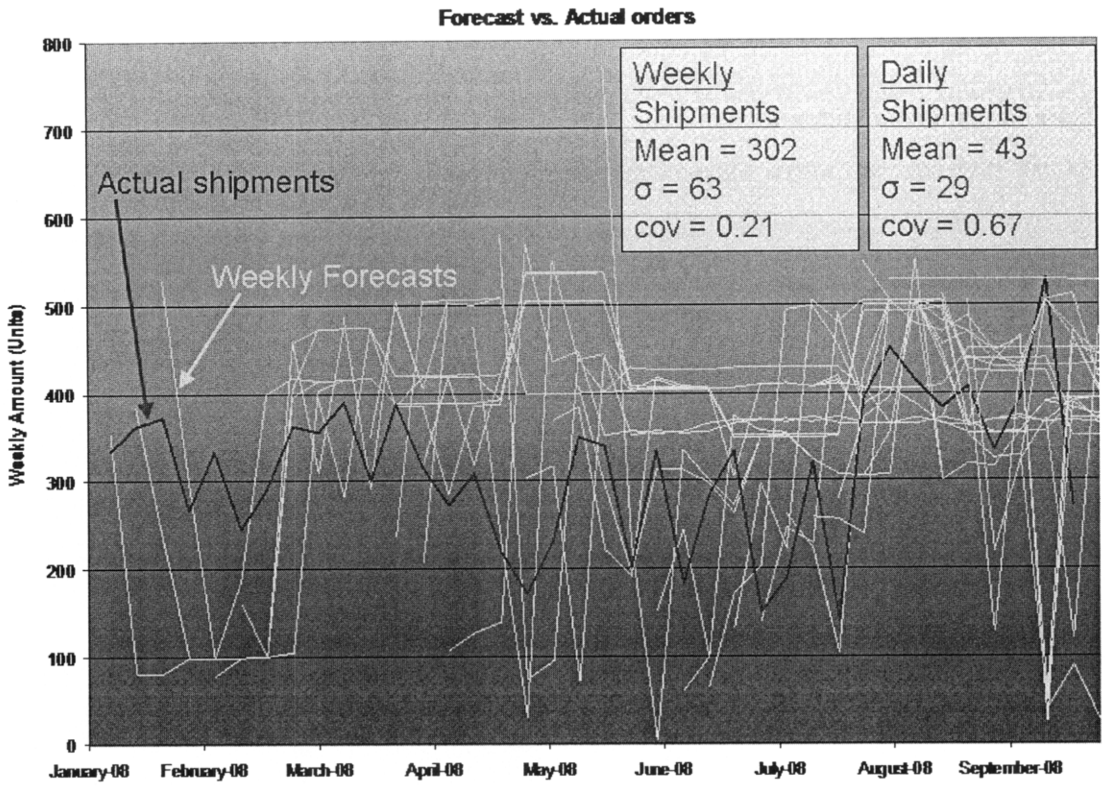

Figure 19: Weekly Forecast and Actual Shipments for Assembly 1

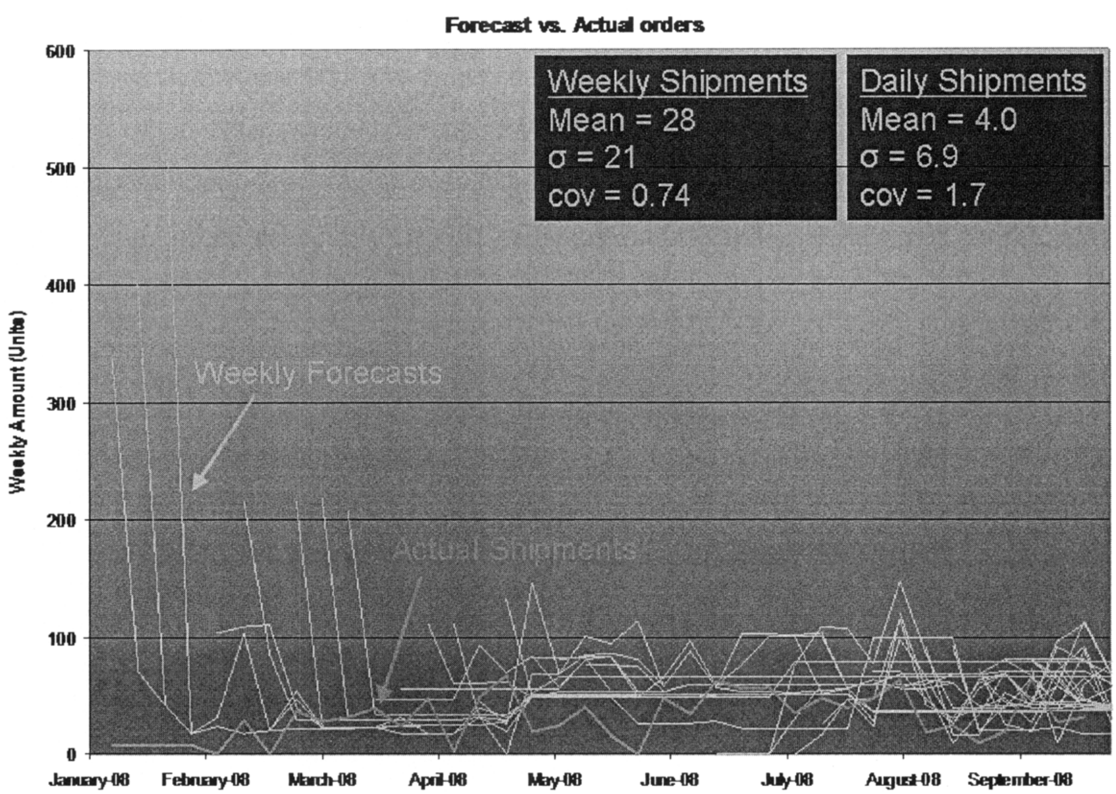

Figure 20: Weekly Forecast and Actual Shipments for Assembly 2

7.3.4 Planned ROP levels for Demand Pull Simulations

As stated above the actual historical weekly MPS signals were used to generate the ROP plan for the Demand Pull simulation. The ROP plan was generated through the use of a modified Excel model that Cisco had developed to show the reduction of forecast error achieved through using the MPS signal propagation logic integral to the Lean 2.0 Demand Pull Initiative. The Excel model incorporated logic, calculations, and rules Cisco and its partners had just agreed upon in the Lean 2.0 Demand Pull Collaborative meetings[44]. The major modification of the existing model entailed enabling use of actual historical data instead of hypothetical data. These modifications allowed the model to take weekly MPS signal data for 26 weeks and actual order data for the same 26 weeks and generate the corresponding 26 week ROP plan for the PCBA Supermarket and for one upstream component buffer. Since the model incorporated Supply Chain production and lead time data it had to be run separately for each component. ROP plans were generated for the PCBA supermarket inventory buffer, the ASIC inventory buffers, and DRAM inventory buffers. Figures 21 and 22 show the resulting ROP plans generated for Assembly 1 and Assembly 2 respectively. The planned ROP levels for Assembly 1 are more stable compared to the planned ROP levels for Assembly 2. The ROP level only changes 2 to 3 times for Assembly 1 during the 26 weeks, while it changes between 5 and 8 times for Assembly 2 during the same time period. The changes in ROP level for Assembly 2 are more severe the first 2-3 months, which is the time period that Figure 20 shows severe positive forecast bias and variability. Once the large positive forecast bias for Assembly 2 is reduced (in mid March) the planned ROP levels also become more stable. The planned weekly ROP levels generated were then input into the Simflex model and were used during the Demand Pull simulation. Another Aspect of the suggested MPS propagation and Demand Pull logic entailed the use of Projected Additional Requirements (PARs). PARs are additional material requirements generated on a one time exceptional basis to reduce fluctuations of the ROP level.

[44] For example, the excel model used a method called the "offset method" to propagate the MPS signal between nodes.

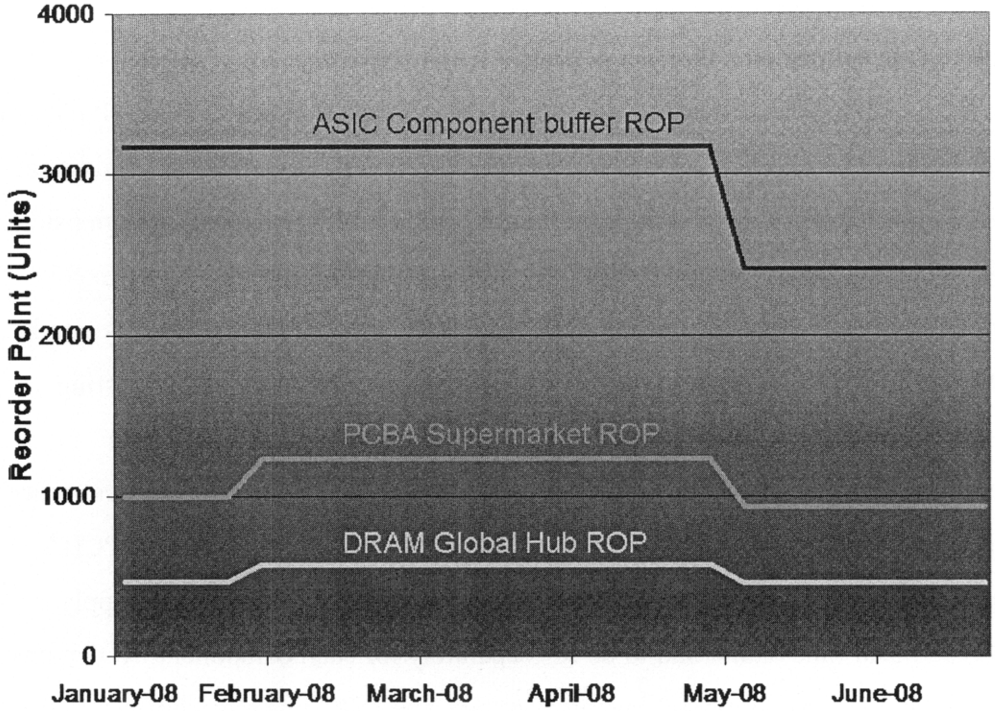

Figure 21: Planned ROP Levels for Assembly 1

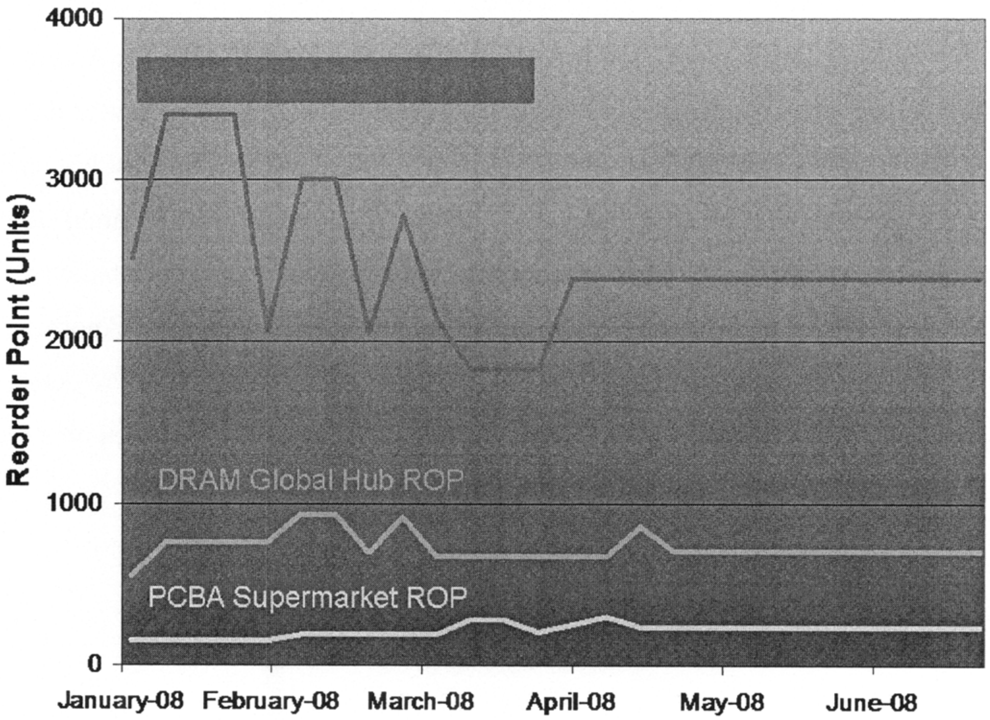

Figure 22: Planned ROP Levels for Assembly 2

The Excel model was able to generate PARs but the author was not able to build this capability into the dynamic simulation. On a positive note, this limitation was only applicable to the simulation for Assembly 2 since Assembly 1 did not generate any PARs. For Assembly 2, out of the 26 weeks modeled, PARs were generated by the model two times for the PCBA Supermarket, six times for the DRAM buffer, and four times for and ASIC buffers respectively. Ignoring these PARs in the simulation may result in stockouts, and could also reduce the amount of inventory in the system which reduces inventory holding costs compared to if the PARs were included.

7.3.5 Other simulation data and simulation verification

The simulation also uses input data beyond what has been discussed above such as actual material costs, production costs, and average selling prices (ASPs) for the period simulated. In addition, the actual inventories of the day that the simulation started were used as starting inventories and safety stock levels were set equal to actual historical safety stocks. However, there was also data that the simulation did not include. For example, Cisco cost data included in the Simulation was limited to Cost of Goods Sold and did not include Selling, General, and Administrative Costs. The simulation did not include actual transportation costs as it was very difficult to collect accurate transportation data for all legs. In order to ensure that the simulation is representative of reality, simulation output data was verified against actual historical data for the same period. Most of the historical verification data was collected at the Flextronics site in Austin, but also through conversations with representatives from IBM and third party logistics providers. For example, it was verified that the simulation mimics the actual average production batch size and actual production batch size. It was also verified that production capacity represents actual capacity, and that average production times and waiting times represent the actual times.

7.4 Project Results and Key Findings

After several rounds of verification and tweaking to get the simulation to represent the actual historical data, the two replenishment methodologies, Push versus Demand Pull, were compared. Dynamic simulations were run for each assembly using each replenishment methodology resulting in four key findings:

1. The Demand Pull replenishment logic compared to push logic resulted in higher supply chain replenishment operating income. Total supply chain operating income was 2% ($2.1M) higher for Assembly 1 (high demand volume and low variability) and 6% ($1M) higher for Assembly 2 (low demand volume and high variability). The key driver was lower overall inventories as a result of Demand Pull replenishment. In particular, fewer inventories were held at post transformational stages. Demand Pull also resulted in steadier consumption and more even flow of material through the line.

2. The Demand Pull methodology resulted in a 50% ($1M) reduction in Supply Chain inventory holding cost for Assembly 1 and a 38% ($0.8M) reduction for Assembly 2. Similar to above, the key drivers here were lower overall inventories and shifting the type of inventory held from high value inventory to lower value inventory further upstream the supply chain.

3. Demand Pull methodology also resulted in reduced production cycle time. For both Assemblies production cycle time was reduced by 18%, corresponding to 2 days for Assembly 1 and 4 days for Assembly 2. The key driver here was that demand pull resulted in runner smaller batches more frequently, making for a steadier flow through the line.

4. The final key finding involves supply chain response time. Interestingly, for Assembly 1 the response time got worse by 8%, while for Assembly 2 the response time was improved by 45%. The key driver was the procurement cycle time and it is likely that this result was an effect of the very large positive forecast bias for Assembly 2 resulting in early build up of finished goods quickly depleting component inventory buffers driving up the procurement cycle time.

Tables 10 and 11 show a financial breakdown and comparison of the Push simulation and the Demand Pull simulation for Assembly 1 and Assembly 2 respectively.

	Push	Demand Pull	Change	% Change
Total Sales	213.7	213.5	-0.2	-0.1%
Material Cost of Sales	93.8	92.5	-1.3	-1.4%
Other cost of sales (assembly & test)	3.7	3.6	-0.1	-3.0%
COGS	97.5	96.1	-1.4	-1.4%
Gross Margin	116.2	117.3	+1.1	+1.0%
Overhead Cost (SG&A)	1.6	1.5	-0.1	-3.0%
Inventory Holding cost	1.9	0.9	-1.0	-50.4%
Operating Expenses	3.5	2.5	-1.0	-29.1%
Operating Income/Loss	**112.8**	**114.9**	**+2.1**	**+1.9%**

Table 10: Supply Chain Financial differences of using Push versus Demand Pull for Assembly 1

	Push	Demand Pull	Change	% Change
Total Sales	72.6	72.5	-0.1	-0.2%
Material Cost of Sales	53.6	53.5	-0.2	-0.3%
Other cost of sales (assembly & test)	0.63	0.58	-0.05	-8.2%
COGS	54.3	54.1	-0.2	-0.4%
Gross Margin	18.4	18.5	+0.1	+0.5%
Overhead Cost (SG&A)	0.9	0.8	-0.1	-8.2%
Inventory Holding cost	2.1	1.3	-0.8	-37.7%
Operating Expenses	3.0	2.1	-0.9	-28.7%
Operating Income/Loss	**15.4**	**16.3**	**+1.0**	**+6.3%**

Table 11: Supply Chain Financial differences of using Push versus Demand Pull for Assembly 2

Figures.23 and 24 show the difference in average total inventories between the push and demand pull simulations for Assembly 1. Figure 23 shows average total inventories in items while figure 24 shows average total inventory value. Similarly, figures 25 and 26 show the same type of charts for Assembly 2. These figures illustrate how using a demand pull methodology instead of a push methodology shifted the type of inventory carried from post transformational, high value inventory to pre transformational lower value inventory. For Assembly 1 the average total raw material inventories actually increases in terms of items, but decrease in terms of value. Similar trends can be seen for Assembly 2.

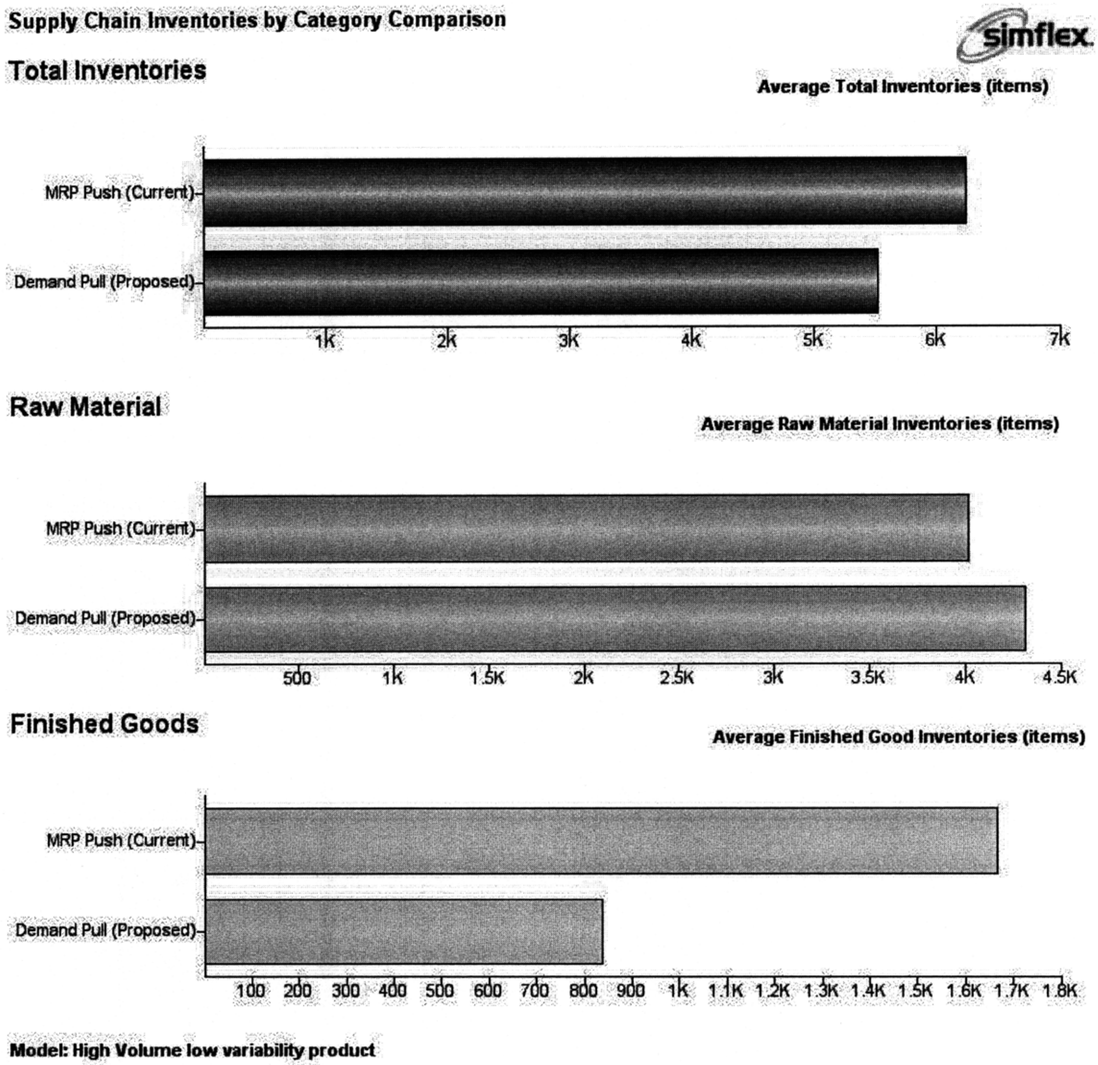

Figure 23: Comparison of average supply chain inventories (items) for Assembly 1

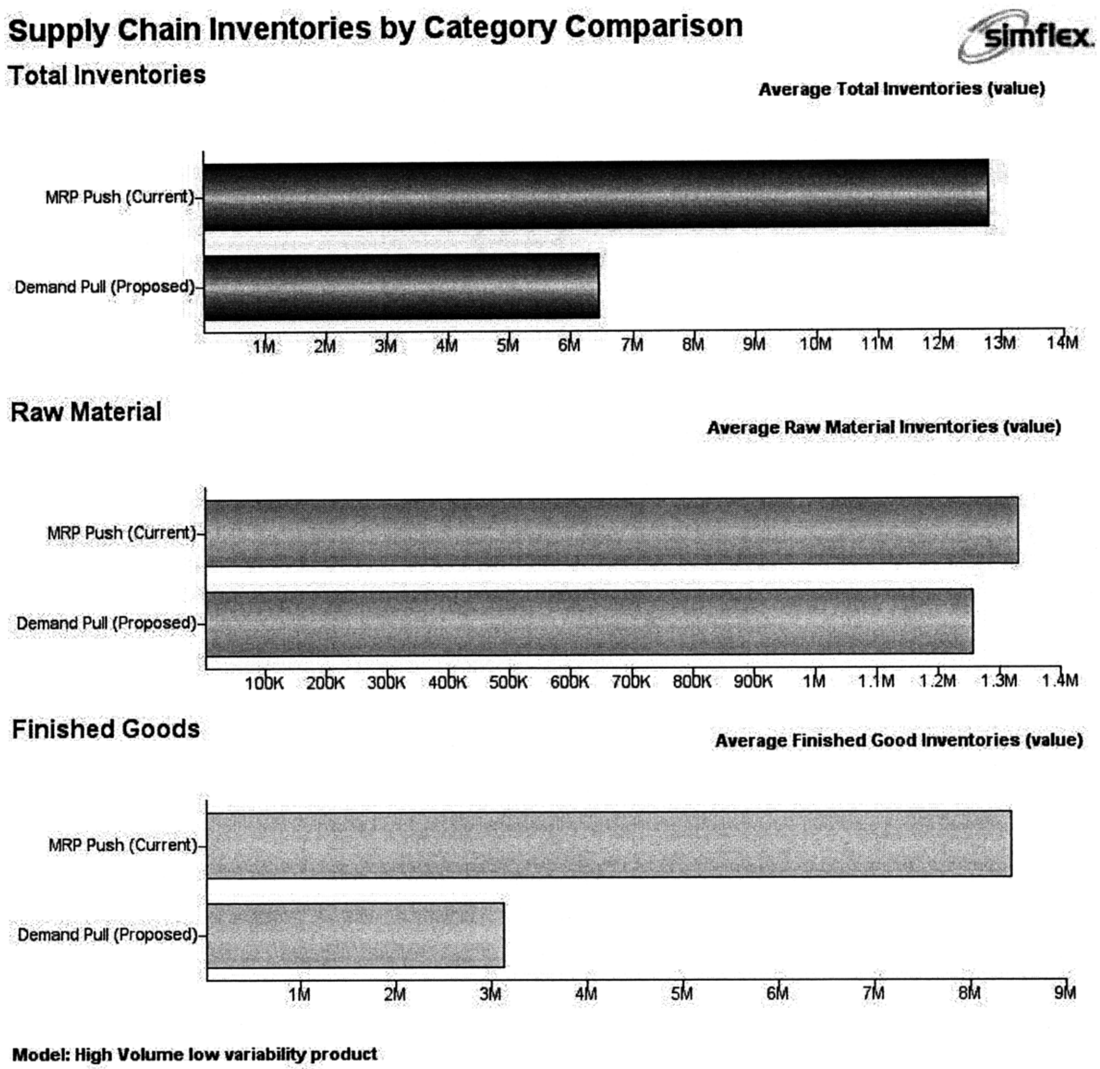

Figure 24: Comparison of average supply chain inventories (value) for Assembly 1

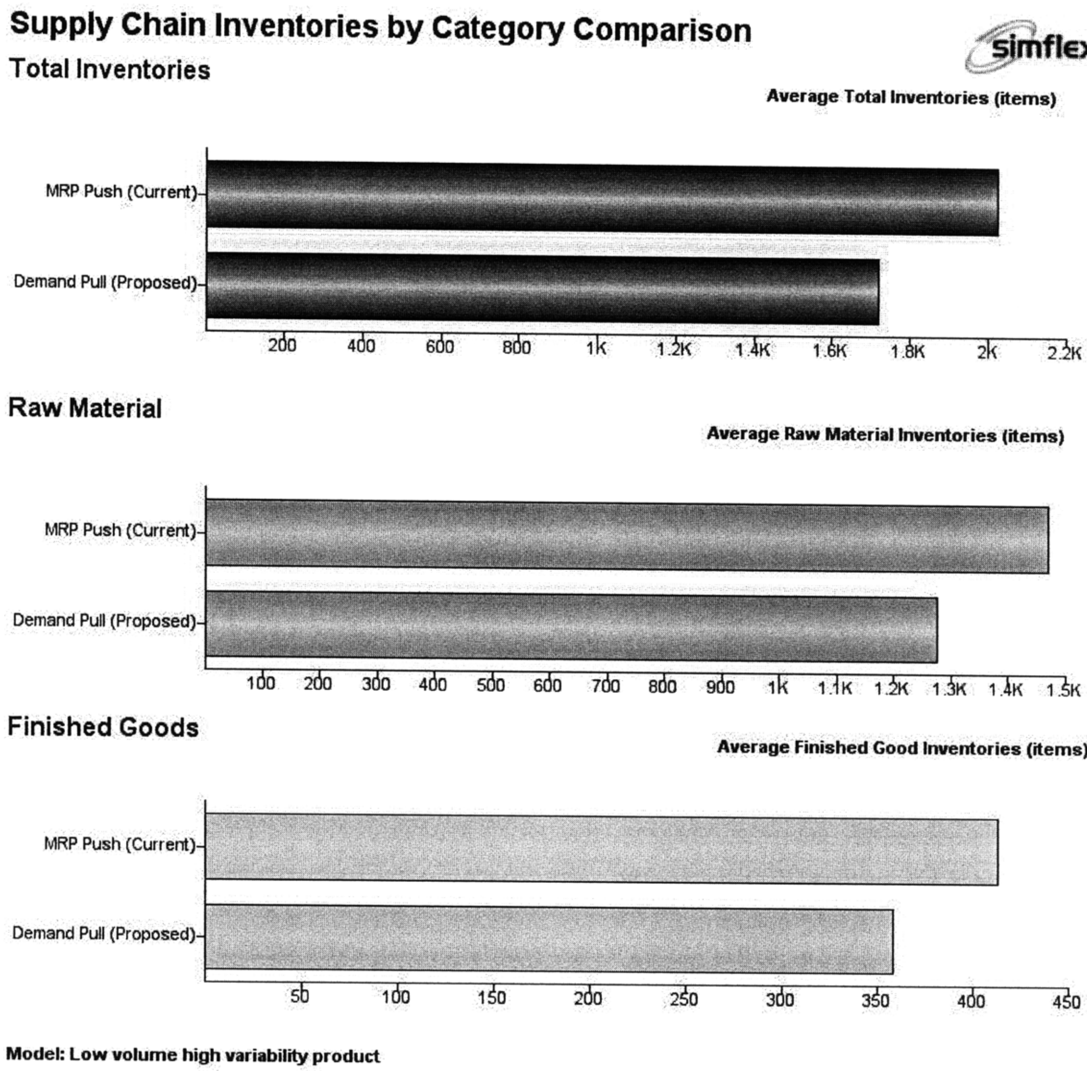

Figure 25: Comparison of average supply chain inventories (items) for Assembly 2

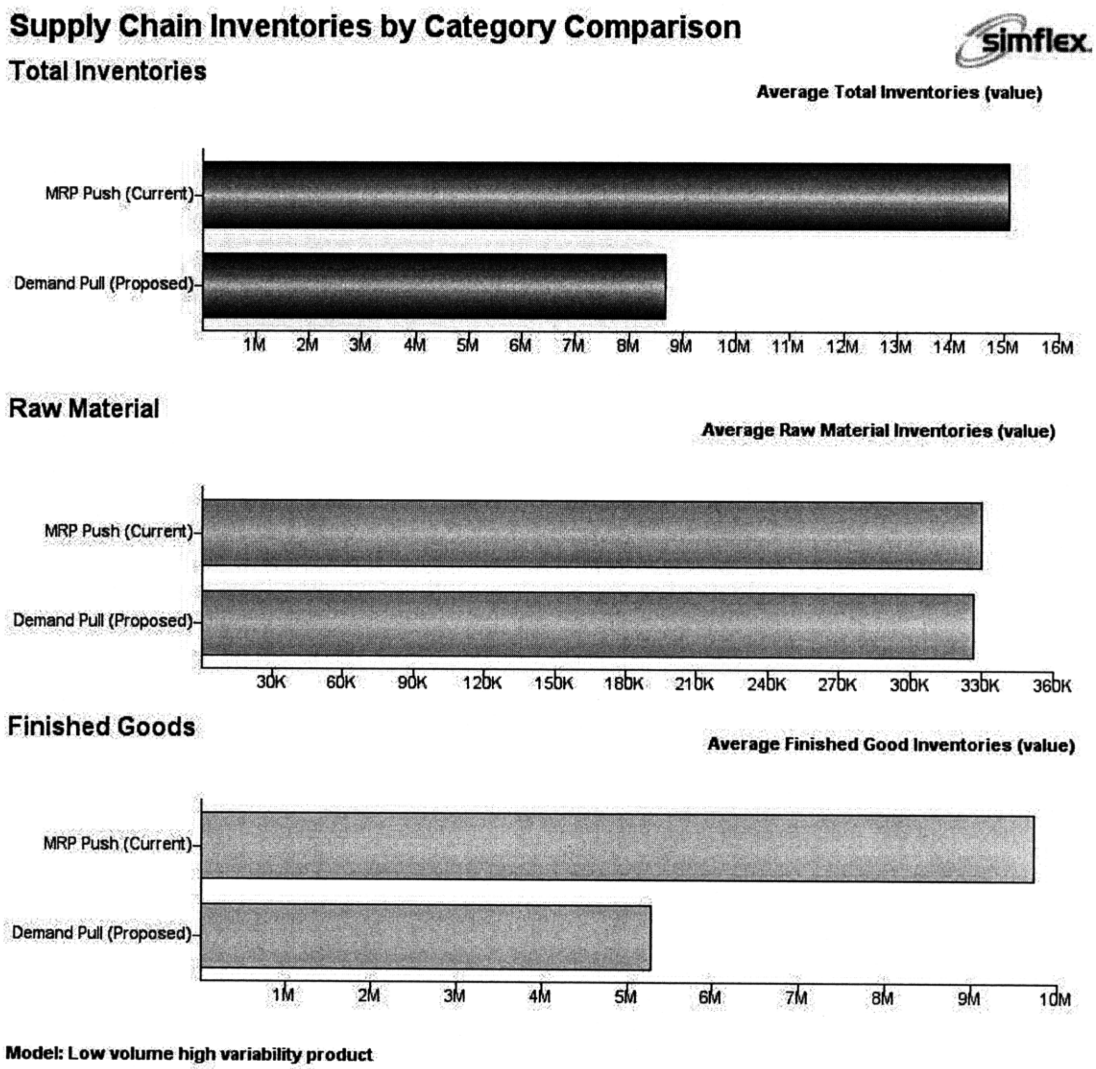

Figure 26: Comparison of average supply chain inventories (value) for Assembly 2

Interestingly, when comparing the inventory levels resulting from the simulations with the actual inventory levels for the same time period one finds that the actual inventories were comparable to those in the Demand Pull simulation. This indicates that Flextronics were already running these two assemblies in a lean fashion. In addition when comparing which company, Cisco, Flextronics, or the component suppliers, benefited the most by using a Demand Pull methodology instead of a Push methodology it was found that most of the inventory cost reductions occurred at Flextronics. Intuitively this makes sense since most of the inventory and in particular the high value inventory is owned by Flextronics and Demand Pull methodology results in a reduction in high value inventory.

Figures 27 and 28 show a breakdown of the supply chain cycle times resulting from the simulations for Assembly 1 and Assembly 2 respectively. Here the total supply chain response time is the time it would take to complete an order if all supply chain inventories were zero at the time the order was placed. The Procurement cycle time is the time it takes to plan procurement, receive and inspect the goods once they arrive, and load them into the warehouse. The production cycle time is the time it takes to get the goods on the production line, setup the line, and manufacture the product. The order fulfillment cycle time is the time it takes to process and deliver a customer order. These figures show how demand pull resulted in an increase in the total supply chain response time for Assembly 1 and a reduction in response time for Assembly 2, and how this response time was driven by changes in the procurement cycle time between the different methodologies.

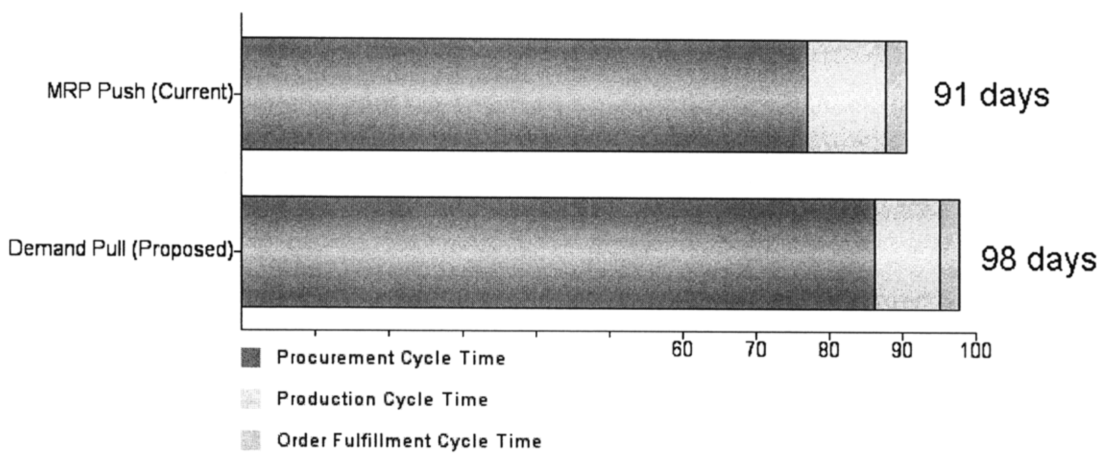

Figure 27: Supply Chain Total Response Time for Assembly 1

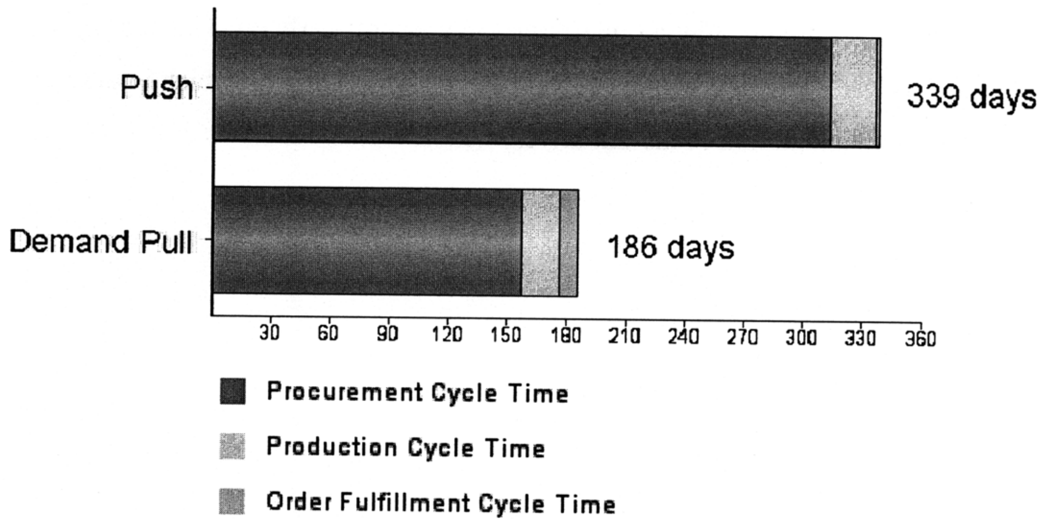

Figure 28: Supply Chain Total Response Time for Assembly 2

In summary, this simulation study shows that there are differences between using a push methodology and a Demand Pull methodology. More specifically, the dynamic simulation showed that the proposed Demand Pull replenishment methodology when compared with a traditional push methodology results in reduced supply chain inventory costs and increases supply chain operating income. The key driver was a reduction in high value inventory levels at Flextronics. It was also found that the impact to supply chain response time was case dependent due to different procurement cycle times. For next steps the author suggests additional simulations and sensitivity analysis to be performed. This will allow a better understanding of the impact and key drivers of using a Demand Pull replenishment methodology. In particular the key drivers for supply chain response time and procurement cycle time should be studied further. The author also suggests these results be shared with the other manufacturing partners involved in the Demand Pull initiative and utilized to enhance collaboration within the initiative. Perhaps most importantly this study presents a data driven approach to evaluating a supply chain improvement prior to implementation of the improvement. By using historical data the analysis could be verified to ensure accuracy of the simulation. The use of actual historical data ensured both Cisco and Flextronics stakeholders felt comfortable with the simulation. If this type of analysis had been performed at an earlier stage in the effort it would have been much more valuable as it could have been used to address questions and concerns early on. This type of joint data driven analysis can ensure buy in is achieved by all stakeholders early on which in turn helps drive a smoother implementation of the initiative.

8 Summary of Recommendations and Conclusion

This chapter is divided into two sections. First, a summary of the findings and recommendations made in the previous chapters is provided. Then, the thesis is finalized by a section outlining general conclusions.

8.1 Summary of Recommendations

Mapping the end-to-end order fulfillment process to find inter-company touch and pain points provides a way to identify existing collaboration links between Cisco and Flextronics. It also identifies a need to better understand the collaborative pain inherent in the joint processes. Based on this analysis the following recommendations are suggested for how Cisco and Flextronics can improve their collaboration within the end-to-end order fulfillment process:

- Many of the pain points identified in the end-to-end order fulfillment process map ultimately are a result of problems related to having Cisco's MRP system at the contract manufacturing sites. I recommend a joint re-evaluation of removing Cisco's Oracle system from its contract manufacturing partners' sites. The evaluation needs to take into account the direct and indirect impact the two systems have on end-to-end order fulfillment processes.
- Acting as a link between Cisco and its partners, Cisco's buyer role is very important to ensure business processes are carried out effectively. I recommend developing a clear understanding of how buyer performance and incentives affect and are aligned to the outcome of cross company business processes and practices. This knowledge can then be used to re-evaluate the buyer role, responsibilities, and processes to ensure buyers are not overworked and the role is standardized across business units and partners. Finally, improvements can be made to ensure existing and future processes are carried out effectively and successfully.
- The manufacturing partners are feeling pain due to forecast error as well as forecast changes. Likewise, Cisco complains of pain due to not receiving accurate supply capability reports from Cisco. I recommend a joint Cisco and Flextronics team work to identify the impacts of forecast accuracy and forecast changes to the manufacturing partners as well as the impact of supply capability reporting accuracy to Cisco. This joint understanding should then be used to guide

development of common processes, tools, and communication links to quickly identify and communicate forecast changes and supply capability changes.

- In order to ensure future success of joint initiatives, Cisco and Flextronics should work together to quantify the impact of joint projects prior to moving on with implementation. Emphasis should be on providing data that both Flextronics and Cisco feel comfortable with and can trust such that the hesitation felt by both Flextronics and Cisco team members can be removed or at least reduced.

From the three lens analysis of the Lean 2.0 Demand Pull initiative the major finding is that the value of the initiative was not clear to all participants prior to moving on with project execution. If Cisco had been able to better convince its partners of the value that the initiative would bring the driving force moving the initiative forward would be coming from both Cisco and the manufacturing partners, resulting in a stronger and closer collaborative effort. Instead, the initiative has been relying on Cisco's power as the customer to drive project execution. Cisco's value proposition has not convinced the partners and hence did not constitute the incentive for collaboration that Cisco intended. In order to convince the partners Cisco need to tailor their analysis and presentation to the partner's data and analysis requirements. This will make them much more likely to give a presentation that is more compelling to the partner. In addition, Cisco needs to ensure the material is presented to the right people. Cisco can do so by first gaining a better understanding of how decisions are made in each organization and then focus on convincing the appropriate and powerful people within each organization. Another recommendation is to gain the partners trust by involving the partner in the analysis. In my interviews and observations I have found evidence of low levels of trust between the two organizations as well as differences in how trust is gained within the two organizations. Cisco's project managers may have a high level of trust in the data that has been presented, while Flextronics project managers have a low level of trust in the same data, rendering the data less convincing for Flextronics. Questioning the validity of data and assuming that numbers have been tweaked to result in the desired outcome is common, especially when it involves pricing. My final recommendation to improve collaboration is to ensure there is a clear link between the project and each partner's strategy and vision. Collaboration will be the healthiest when everyone involved with the initiative is convinced that the initiative will provide value for his or her organization.

The Survey based on Hansen and Nohria's framework identified inability to seek and find experts as well as documents and information within and across Cisco and Flextronics as the leading barrier to effective collaboration. In particular Flextronics experts and documents are difficult to find. The survey also shows that there is a gap in how Cisco and Flextronics team members perceive each other. Most of the time team members from their own company were rated as having fewer problems with collaboration barriers compared to team members from the other company. By focusing on creating lateral cross unit mechanisms, both formal and informal this barrier can be reduced. Informal cross unit mechanisms can for example be professional networks, people, and joint teams that act as connectors between the companies. Perhaps the buyer role should be more formally utilized as a cross unit mechanism. Formal cross-unit linking mechanisms such as knowledge management databases and benchmark systems can also provide useful to reduce the barrier. I suggest improving the current Lean 2.0 SharePoint site to make it more useful by including more information on team members and experts. I also suggest complementing the SharePoint with web3.0 technologies to make it easier for people to find each other, connect with each other, and jointly create content and share information with each other. The team should also explore new collaboration technologies such as the collaboratorium model. Finally, it is very important for leaders to nurture the willingness to collaborate that exist within and between Cisco and Flextronics. Leaders should motivate people to continue to seek and provide help to each other by role modeling and rewarding the desired collaborative behavior. It is also important that the leaders within both companies develop and articulate unifying goals that motivate people to work across companies to realize shared goals.

The most significant take away from the Dynamic Simulation exercise was the need for an objective analysis using actual historical data. Stakeholders from both parties are more likely to accept the results of an analysis that uses historical data, especially when the analysis is performed by a joint resource. I recommend that for future large initiatives where stakeholder buy in is crucial for successful implementation similar joint analysis should be performed in the early stages of the initiative. By using historical data and joint resources to perform the analysis it is easier to gain trust in the analysis from stakeholders. Performing the analysis at an early stage in the initiative will allow questions and concerns to be addressed early and ensures all parties completely buy in to the initiative prior to embarking into the implementation phase. Finally, this type of joint analysis should be incorporated into the initiatives knowledge management system. The goal should be to allow for similar analyses to be jointly performed, perfected, and shared among the initiative stakeholders through web3.0 technologies.

8.2 Conclusion

In conclusion, through this study I have found many impressive examples where collaboration between Cisco and Flextronics is thriving and provides tremendous value to both companies. However, in the spirit of continuous improvement, cross-company collaboration can only be improved by first understanding the current state of collaboration. In order to propose appropriate improvements, a characterization of the current state of collaboration between the two firms was performed and collaboration gaps and opportunities for improvement were identified. The study focused on Cisco and Flextronics supply chain organizations and more specifically Cisco's Lean 2.0 Demand Pull Initiative, a major multi-company collaborative supply chain improvement initiative between Cisco and Cisco's four major contact manufacturers (CMs): Celestica, Flextronics, Foxconn, and Jabil. The current state characterization of Cisco and Flextronics collaboration was performed by using a combination of end-to-end order fulfillment process mapping, interviews, direct observation, and application of existing frameworks from literature. Finally, a dynamic supply chain simulation was performed to address a specific collaborative pain point within the Lean 2.0 Demand Pull initiative.

This multi-pronged approach to identifying collaboration gaps resulted in recommendations ranging from very specific to more general. In general, Cisco and Flextronics can improve the effectiveness of their collaboration within this large joint initiative by promoting and using cross unit linking mechanisms to make it easier to locate information and experts within both companies, but in particular within Flextronics. These mechanisms can be in the form of connector people (such as Cisco's buyers), or in form of knowledge management and benchmarking systems. Cisco and Flextronics can promote cross unit linking mechanisms through networking events and by creating joint teams and committees. They should also further expand their current resource sharing model where new employee externships are set up at the partner company to help align the two organizations and help each organization learn its partner's culture and better understand one's partner. In addition, the Lean 2.0 initiative presents a great opportunity to experiment with technologies such as web3.0 or new collaborative models such as the collaboratorium model to help stakeholders across companies and geographic locations connect, collaborate, create and share knowledge. The companies can also use the concept of collective intelligence to measure and improve collaboration in joint initiatives and teams. In addition, improving trust between the organizations will help stakeholders be more open to accepting data and analysis presented by other parties. It is important for both companies to understand how, and to whom, they should present data to make the presentation meaningful to stakeholders from the other party. Leaders on both sides should role model honesty and integrity, but it is also crucial that stakeholders feel that their well-being is cared about by both organizations. Leaders can accomplish this by deepening their understanding of issues on both sides and ensuring that accountability for metrics is shared in a clear way between the two companies. They should also create and communicate goals and values that are shared between the companies.

Although this study focuses specifically on collaboration between just Cisco and Flextronics, it is the author's hope that the observations, findings, and recommendations presented will provide valuable information for all stakeholders within the joint initiative and lead to improved future inter-company collaborative efforts beyond this initiative - both in Cisco and its partners, and in other companies pursuing similar business structures.

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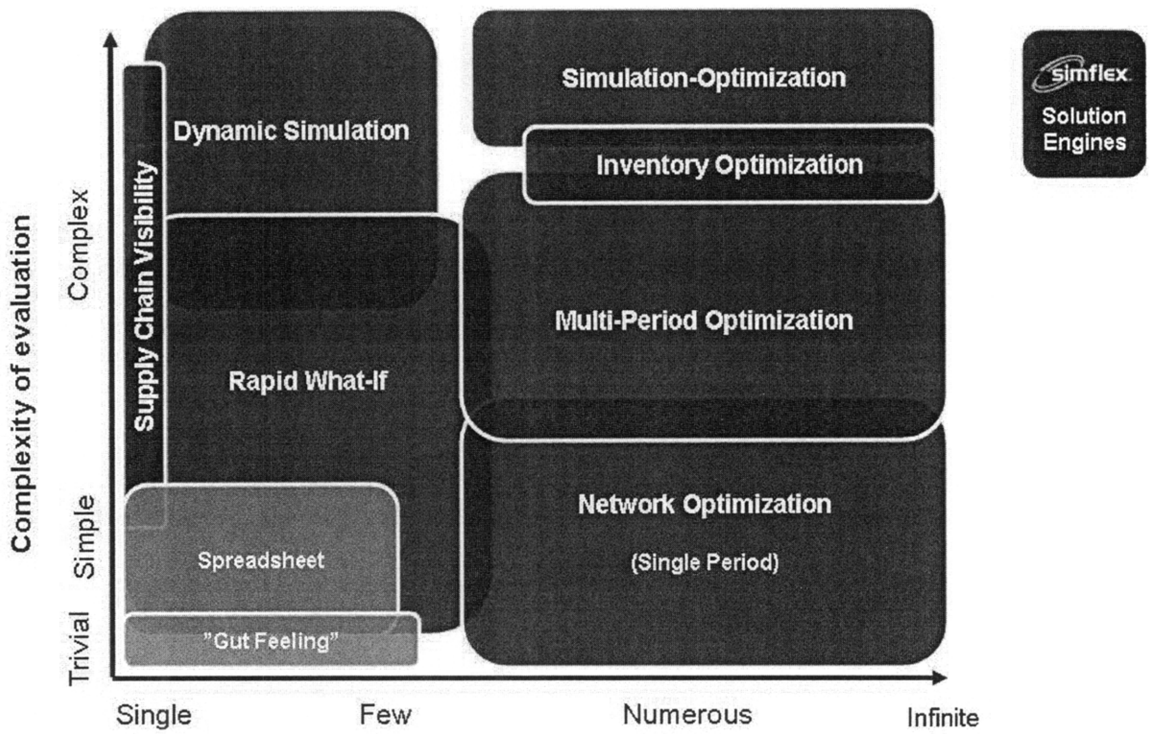
Appendix 1

Simflex Technologies



APPENDIX 2

Hansen and Nohria's survey to assess the extent of collaboration barriers present within an organizational unit.

Which barriers to collaboration are present in your organizational unit?

Assess your unit from 1 (not at all) to 100 (to a large extent)

First Barrier: Unwillingness to seek input and learn from others

1. Even when they need help, our employees are not willing to seek input from outside their organizational unit.
2. When faced with problems, employees in our unit strive to solve them by themselves without asking for help from outsiders.
3. There is a prevailing attitude in our unit that people ought to fix their own problems and not rely on help from others outside the unit.

Second Barrier: Inability to seek and find expertise

4. Our employees often complain about the difficulty they have locating colleagues who possess the information and expertise they need.
5. Experts in our company are very difficult to locate.
6. Our employees have great difficulties finding the documents and information they need in the company's databases and knowledge-management systems.

Third Barrier: Unwillingness to help

7. Our employees do not share their expertise and information for fear of becoming less valuable.
8. Our people keep their expertise and information to themselves and do not want to share it across organizational units.
9. Our employees seldom return phone calls and e-mails when asked for help.

Fourth Barrier: Inability to work together and transfer knowledge

10. Our employees have not learned how to work together effectively across organizational units to transfer tacit knowledge.
11. Employees from different organizational units are not used to working together and find it hard to do so.
12. Our employees find it difficult to work across units to transfer complex technologies and best practices.

Source: Hansen, M. T., Nohria, N. (2004), *How to build collaborative advantage,* MIT Sloan Management review, Fall 2004

APPENDIX 3

Cisco and Flextronics methodology used to Calculate weekly ROP levels

Basic Formula: Consumption over Lead Time + Safety Stock

Mathematically: (LT) x (Avg. Consumption) + (SD) x (Z)

Avg Consumption

- Quantity Consumed over Lead-time
- If CT2R (Cycle time to Replenish) = 2 weeks, Avg consumption will be calculated in 2 week buckets

LT - CT2R

- Time To Replenish (Make = build cycle time; buy = component lead-time)

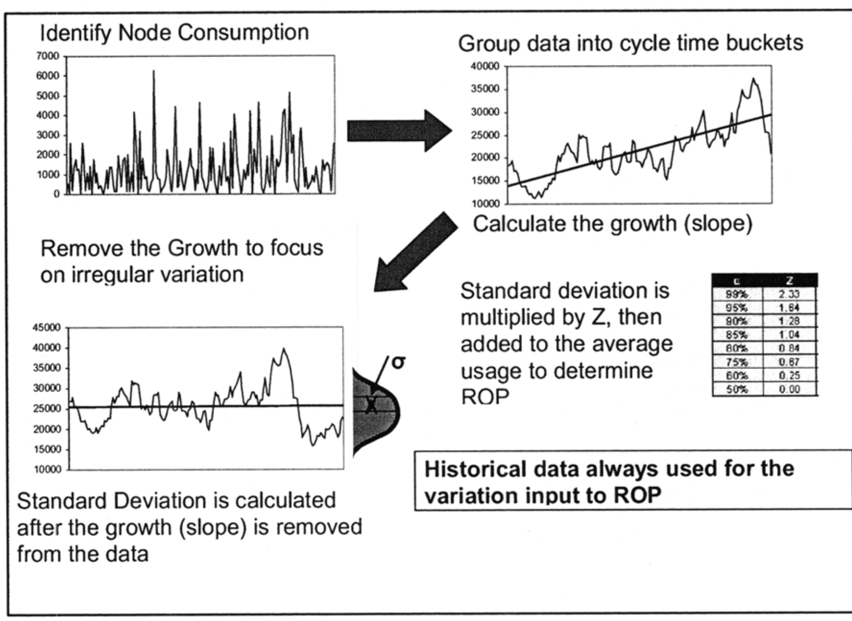
SD

- Standard Deviation of the consumption over the specified time period (forecast error)

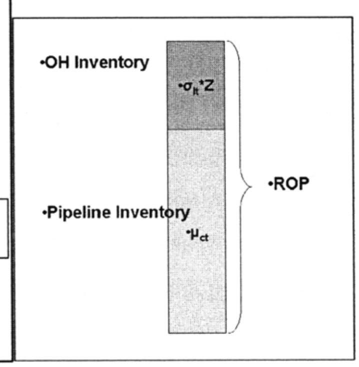
Z - Service Level Factor

- Set to 99% at ship level, meaning that our service level to Cisco will be 99% to meet OTS within CT2R
- Probability that material will be available to meet demand

SD x Z = Safety Stock (Always Calculated using historical consumption)



α	Z
99%	2.33
95%	1.64
90%	1.28
85%	1.04
80%	0.84
75%	0.67
60%	0.25
50%	0.00



Source: Cormia, C. (2008), *Course Title - ROP,* Flextronics Internal Training Document, October 2008