

Creating a Sustaining Value Engineering Function Within Worldwide Manufacturing

By

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Bachelor of Science in Mechanical Engineering, University of Michigan, 2001

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Master of Business Administration

AND

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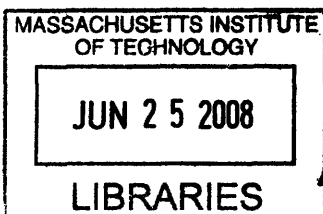
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ABSTRACT

Most product cost reduction in industry occurs during new product introduction (NPI). However, for some firms, a case can be made that product cost reduction efforts can be devoted towards products already in sustained production. These firms face a set of business conditions that often preclude exhaustive product cost reduction during NPI. These conditions include fast time to market requirements and the necessity of devoting engineering resources to a pipeline of innovative products needed to remain competitive in the market. These firms' products also possess characteristics that make cost reduction during sustained production viable. Products have sufficiently long lifecycles in which to realize project savings and a market that will continue paying prices that enable continued profitability. However, as expected, these firms often must devote resources to more pressing NPI needs, leaving sustained product cost reduction savings under-realized.

Cisco Systems is a firm that faces these business conditions and has products that have these characteristics. Cisco Worldwide Manufacturing has thus devoted itself to improving Cisco's value engineering capabilities to a world class level. Value engineering at Cisco refers to product cost reduction activities that occur during sustained manufacturing. The research in this thesis set out to validate the hypothesis that Cisco could improve value engineering savings by funding cost reduction projects directly through Worldwide Manufacturing, rather than through the typical budget of a Cisco business unit. Cisco business units often have to prioritize NPI over value engineering. This thesis will discuss the process and results of a model that was established to provide value engineering project funding through Manufacturing. Results show that value engineering savings can be increased with this funding model.

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1.0 Introduction

Product cost is a key variable for any firm in product development. For any product, a firm must balance cost against other variables to ensure that value is delivered to both itself and the consumer. Cooper and Slagmulder (1997, p. 31-33) lay out this balance in what they call the product survival triplet. In the triplet, cost (or price in a consumer's view) is balanced with product functionality and quality. Functionality and quality have both a minimal allowable level and a maximum feasible level. Price, similarly, has a maximum allowable price and a minimum feasible price. Allowable cost is reflected through the price that consumers will pay. Firms must choose where to place their products within the boundaries allowed by the survival triplet. This thesis will focus on product cost but must recognize the other factors at play in the delivery of products to market.

The amount that a firm must focus on product cost is dependent upon its business environment. Firms in high-innovation industries are often forced to sacrifice attention to product cost as speedy time to market is required to keep up with or ahead of the innovation from competitors. Fortunately, firms in high innovation industries often have gross margins resulting from innovative products that allow them to sacrifice focus on product cost. On the other hand, firms in industries with lower innovation must often focus relentlessly on product cost as their gross margins are typically lower. An example of this would be the automotive industry.

This thesis focuses on a firm in an industry where bringing innovative cutting-edge technology to market is a critical driver of the firm's success. The firm's gross margins are large and time to market is a critical product development driver. As such, product cost savings are often still available when a product enters sustained production. The purpose of this thesis is to determine whether firms such as this can improve product cost after a product is in sustained production.

Three characteristics must be present within a firm to make product cost reduction activities during sustained production viable.

- The firm must have a significant business reason to forego product cost reduction efforts in the new product introduction (NPI) phase of the product lifecycle. Otherwise, cost reduction in NPI is preferable.
- The lifecycle of a firm's products after product introduction must be long enough to allow time to complete a product cost reduction project and for savings to result from the project that provide a positive financial return.
- The product market justifies a product cost reduction project. The firm must still be able to sell the product at prices that will guarantee savings after the project is complete.

These three characteristics were present at Cisco Systems, the firm at which the project presented in this thesis was conducted at from June through December 2007. This project consisted of establishing a process to allocate supplemental funding for value engineering projects through Cisco Worldwide Manufacturing. Value engineering at Cisco refers to product cost reduction activities that occur after a project is in sustained production. The process established ways for value engineering projects to be identified, evaluated, funded, and monitored.

2.0 Cisco Systems Introduction

Cisco Systems is an industry leading supplier of internet protocol (IP) networking equipment. With a mission of “Changing the way we work, play, live, and learn,” Cisco aims to dominate the world’s networking needs for data, voice, and video content. Additionally, Cisco has coined the slogan “Welcome to the Human Network.” This phrase represents Cisco’s belief in Web 2.0, a phase in which users will collaboratively define and create the content that they use over the network. Cisco’s goal is to provide the means for this network evolution to occur.

Cisco’s core products remain its internet switches and routers which represent 36% and 20% respectively of its 2007 sales. However, Cisco is constantly branching out into new areas as it strives to strengthen its presence in new customer segments and new areas critical to network content delivery. These areas include storage networking, wireless networking, and network security. Cisco’s acquisitions of Linksys and Scientific Atlanta in the last five years have increased its presence in the small business and consumer market segments. Additionally, internal expansion into internet telephony, Telepresence, and the acquisition of Webex, a leader in network meeting and collaboration applications, has increased Cisco’s voice and video content delivery offerings.

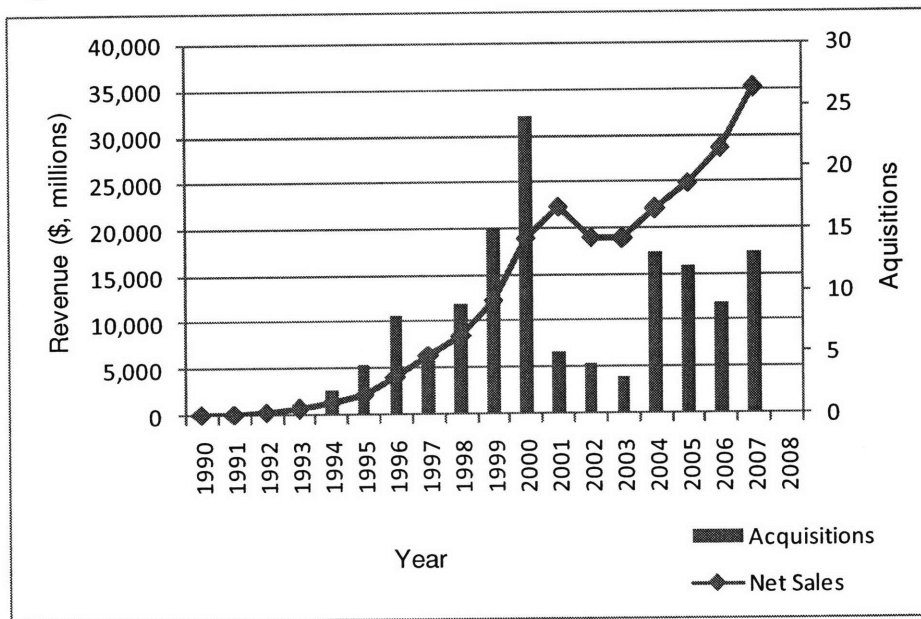
2.1 Cisco Systems History

Cisco was founded in 1984 and went public in 1990. Throughout the 1990s Cisco experienced the phenomenal growth typical of the high-tech industry. After mirroring the high-tech industry’s drop in performance in 2001, Cisco has once again experienced steady growth. Cisco’s growth is innovation driven and has been enabled by the company’s consistency in bringing technologically superior products to market. Padmasree Warrior (“A Conversation with a Warrior”, 2007), Cisco’s newly hired chief technology officer, said that one of the things that most attracted her to Cisco was its “almost unwavering focus on innovation.” Cisco’s innovation is due both to internal research and development and acquisitions. Cisco has acquired 127 companies as of November 2007, with the first being Crescendo Communications in 1993.

Cisco currently employs over 60,000 employees in an organization that spans the globe. Revenues for fiscal year 2007 were \$34.9 billion with gross margins of \$22.3 billion. R&D

spending was \$4.5 billion. Figure 1 shows Cisco's annual revenue and number of yearly acquisitions since 1993. Cisco's acquisition rate has rebounded along with its revenue since the 2001 industry downturn.

Figure 1: Cisco Revenue and Yearly Acquisitions since 1993



2.2 Cisco's Market Position

Cisco is a dominant industry leader in the overall IP network communications industry. Because of Cisco's commitment to compete across the network spectrum, its competitors are varied and most do not compete in every business that Cisco is in. Some main competitors include Juniper Networks, Alcatel Lucent, and Nortel Networks. Cisco's annual sales were greater than all three of these companies combined considering the most recently reported financial data for each company. Other competitors include Avaya, Dell, HP, IBM, and Motorola.

Cisco's market domination is clearly apparent when considering its 92% share of the enterprise router market. Cisco also has 75% of the small business router segment. This shows the power of Cisco's acquisition strategy as 25% of this market share results from Cisco's merger with Linksys. Overall, Cisco controls 70% of the global router market with Juniper Networks second at 14%. Other examples of Cisco's market dominance include its 55% and 60% share of the

enterprise and small business wireless networking markets and its 36% share of the network security market.

2.3 Cisco Business Environment

Cisco is a company that has experienced tremendous revenue growth and that enjoys an enviable market position, both of which it desires to continue. There are two key aspects of Cisco's strategy that are worth examining in light of this.

2.3.1 Gross Margin Protection

In addition to having healthy revenue and strong market share, and perhaps partly due to these two factors, Cisco operates a high gross margin business. Cisco's gross margin for fiscal year 2007 was 64%. This gross margin can be compared to those of companies in other industries such as General Motors (21% in 2006) and Boeing (20% in 2007). Although Cisco's gross margin is still high, it has slipped in recent years from an all-time high of 70% in 2003. Part of this is due to the acquisition of firms like Linksys and Scientific Atlanta that while securing new revenue streams for Cisco's router and switch product portfolios, are lower margin (Vogelstein, 2004).

Cisco views the preservation of its gross margins as a business priority. Preserving high gross margins ensures Cisco's profitability from operations and serves as a good target metric to prevent Cisco products from becoming commodities. With an outsourced manufacturing model, Cisco must avoid the potential cannibalization of its products by lower cost partners as has happened in the PC industry. Gross margin is a financial metric that ensures this. In order to maintain these gross margins, Cisco must constantly bring difficult to imitate, innovative products to market that allow it to charge the prices required to drive revenue and to stay ahead of the competition.

2.3.2 Outsourcing

Nearly all of Cisco's products are manufactured and assembled by outside contract manufacturer (CM) partners. Cisco management believes that the actual production represents what Beckman and Rosenfeld (2008) call a "*mission critical context activity*." A context activity is an activity

that while critical to a firm's success, is best left to a partner who can specialize in it. This way, a firm can focus its resources on "*mission critical core activities.*" These activities are those that provide the firm a competitive advantage in the market. In Cisco's case this core activity is new product introduction. New product introduction is where Cisco wants to focus the bulk of its financial and human capital. Cisco does, however, work closely with its CM partners in areas such as product testing, manufacturing quality, and in managing information and financial flows as described by Beckman and Rosenfeld. Indeed, supply chain design at Cisco is arguably even more important for smooth introduction of new products than at a traditional manufacturing company due to the added complexity that comes from outsourcing context activities that are still mission critical.

2.4 Clockspeed

Cisco's outsourced manufacturing model and desire to protect its gross margins necessitate product innovation. Cisco's industry context provides further necessity for Cisco to innovate. This can be seen through the ideas of clockspeed and temporary advantage put forth by Charles Fine. Fine (1998, p. 6) defines clockspeed as the rate at which industries evolve. Industry clockspeed can be further divided into product, process, and organizational clockspeed. Industries with short product lifecycles are said to have fast product clockspeed. An example of such an industry would be athletic footwear where product lines are refreshed seasonally. Industries with long product lifecycles are said to have slow product clockspeed. An example of such an industry would be commercial aerospace, where 20 years can elapse between new products. Clockspeed is driven by the rate of innovation and the competitive intensity within an industry (Fine, 1998, p. 26). The more innovation and competition there is within an industry, the faster its clockspeed.

Another idea put forth by Fine is that of temporary advantage. In the face of clockspeed, no firm can hold a sustained advantage based on its existing technology and competencies. The faster the clockspeed of an industry, the less likely a firm can maintain a sustained advantage. As industries mature, there is a tendency for specialization to develop and for products to become modular. Smaller, faster firms in a specific area of the value chain become competitive. In light of this, established firms have to decide in which area of the value chain to participate.

An example of this is the personal computer industry. As the industry became modular in the 1980s, firms had to decide where to plant themselves. The power in the value chain became noticeable. Microsoft and Intel began to dominate in the operating system and microprocessor areas respectively. These areas are where the innovation in the PC industry is as they have a large effect on the value of a computer to a consumer. Firms that planted themselves in the assembled hardware area of the value chain found their assembled PC products commoditized. Many assembled hardware firms also made the decision to outsource the actual assembly. Because the assembly of a PC is a commodity input, this has started to lead to a situation where CM partners are becoming industry competitors themselves, selling near equivalent PCs for lower prices. The lack of innovation available to assembled hardware manufacturers is starting to erode their business.

The ideas of clockspeed and temporary advantage can be used to provide an overview of Cisco's business climate. Cisco operates in an industry with fast clockspeed, high rates of product innovation, and competitive intensity. To thrive in this environment, Cisco must constantly innovate faster than its competitors. Cisco CEO John Chambers (2006) states that to "stay competitive, it is important to have the courage to innovate on a continual basis." This is especially true in its emerging businesses such as IP telephony (Vogelstein, 2004). As previously mentioned, Cisco innovates both through internal R&D and acquisition of smaller niche firms. Cisco thus maintains its dominance in the IP networking industry not through a continuous sustained advantage but through a temporary advantage that is continuously refreshed through innovation.

Cisco has clearly established where and how it is going to participate in the IP networking industry value chain. Cisco focuses on its core, new product introduction, while outsourcing its context, manufacturing. In doing this, Cisco must ensure that its products will not be cannibalized by its own partners, as in the PC industry. By constantly innovating, Cisco is preventing this from happening.

The theories of clockspeed and contemporary advantage put forth by Fine assert that no company can maintain a sustained competitive advantage. This would not bode well for a large company

like Cisco. However, Cisco is effectively maintaining a continuous temporary advantage over its competitors by focusing on innovation and outsourcing the context. Cisco's innovation allowed it to make the decision to disintegrate through outsourcing while maintaining market dominance.

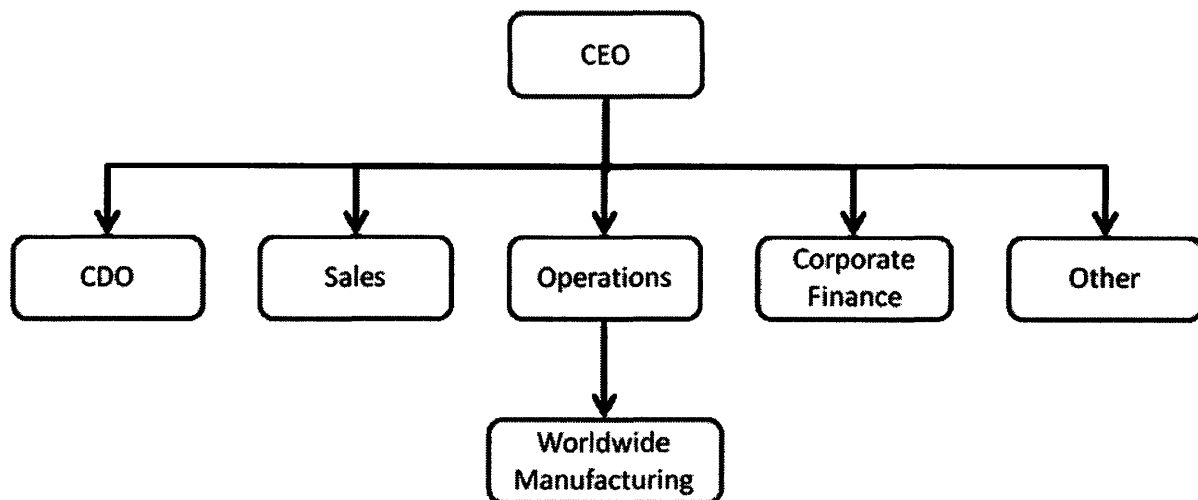
3.0 Cisco Product Development and Supply Chain Design

Cisco operates in a fast clockspeed environment, strives to protect its gross margins, and outsources its manufacturing. Thus, the lifeblood of Cisco's continuing competitive presence is its product development and supply chain design. Cisco must constantly bring innovative products to market to maintain share and prevent a powerful rival from permanently entrenching. This section examines Cisco's product development structure, process, and motivations.

3.1 Organizational Structure

Cisco is aligned along functional lines. Below the CEO are functions including Development, Sales, Operations, and Corporate Finance. Figure 2 shows this structure. Worldwide Manufacturing resides within operations. Internally, development is known as the Central Development Organization or more commonly, CDO.

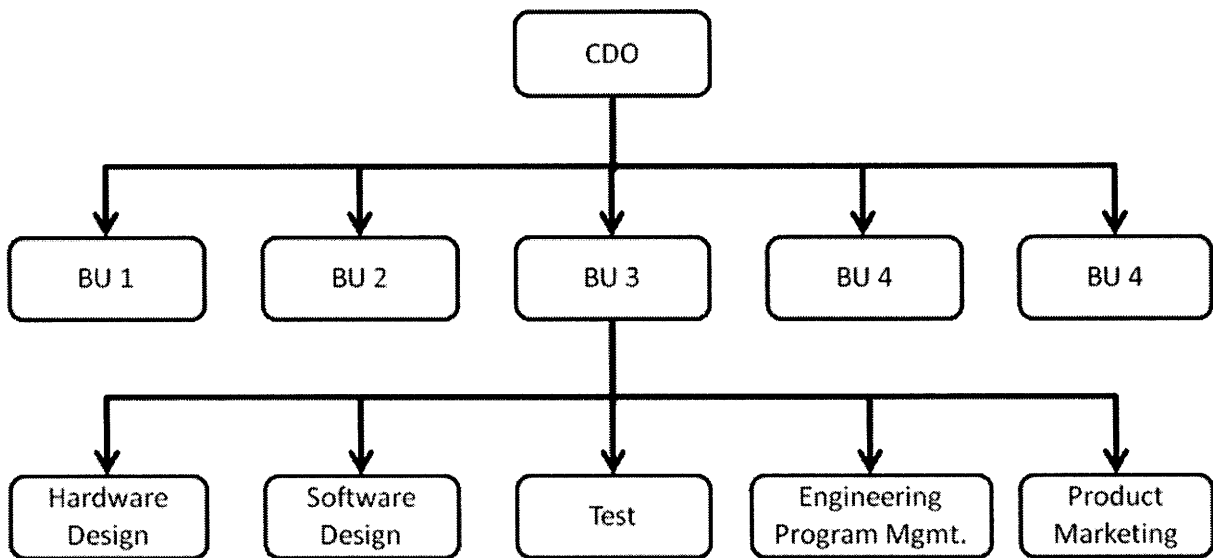
Figure 2: Cisco Organizational Structure



CDO is divided into over 30 Business Units (BU), each of which represents a major Cisco product family, such as edge routers. At times, a new acquisition will be folded into Cisco as a BU. Each BU is responsible for the engineering development and delivery to market of its products. In this role the BUs serve as the profit centers of Cisco. Each BU is headed by a Vice President General Manager who has profit and loss responsibility for the BU. Within each BU are the functions of hardware and software design, test, engineering program management, and

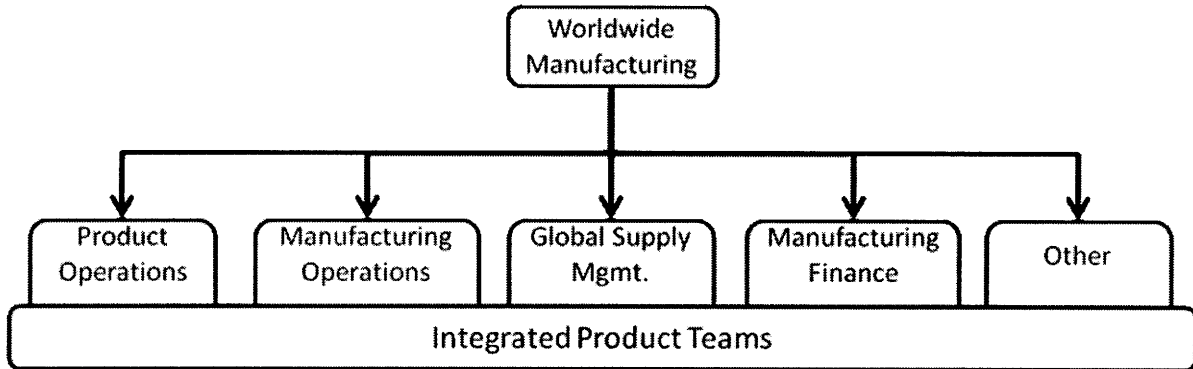
product marketing. Product marketing is specific to each BU and is independent of corporate marketing. Figure 3 shows an organization breakdown of the CDO.

Figure 3: Cisco CDO Organizational Structure



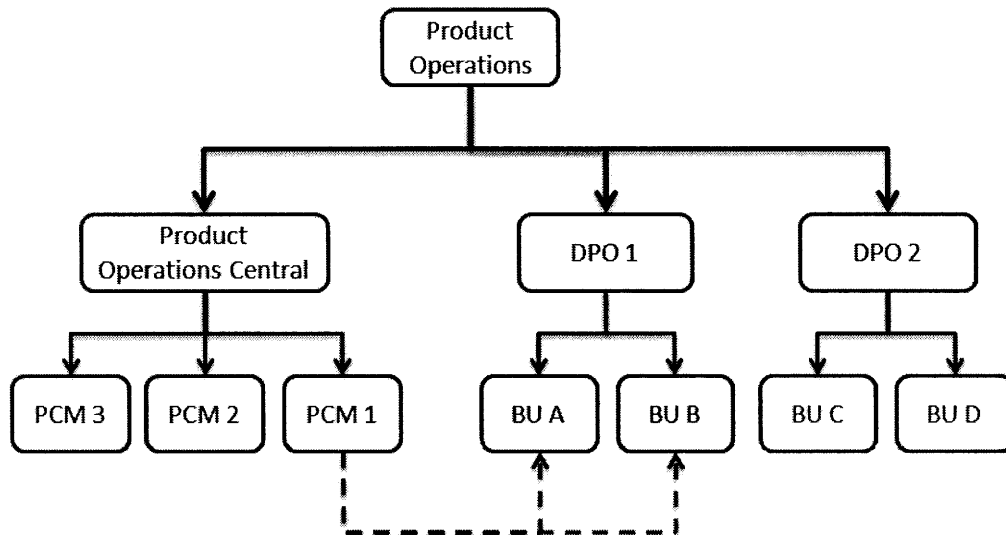
Worldwide Manufacturing serves all BUs. The CDO BUs can be thought of as the customers of Manufacturing. Manufacturing is responsible for transitioning products from the CDO BUs to sustained production at the contract manufacturers and monitoring each project until its end of life. Functions within Manufacturing include Product Operations, Manufacturing Operations, Global Supply Management, and Manufacturing Finance. Figure 4 shows the Manufacturing organization structure detailing a few of these important functions. Manufacturing has also recently developed Integrated Product Teams (IPT). The IPTs are Product Operations led teams that include representatives from all manufacturing functions that have a stake in a product development. The IPTs collaboratively work on product issues relating to launch, cost, and quality. Because they exist within Manufacturing, IPTs do not include design hardware and software engineers who are from the CDO.

Figure 4: Cisco Worldwide Manufacturing Organizational Structure



The work for this thesis was carried out as part of the Product Operations group. The Product Operations group is headed by nine Directors of Product Operations (DPO). Each DPO heads sub-groups that are specifically paired with a CDO BU. A DPO will typically be responsible for several BUs and will have a staff of New Product Program Managers (NPPM) and New Product Introduction Engineers (NPIE). Product Operations also includes a centralized group, Product Operations Central (POC), that handles activities across the DPO groups. One of these activities is tracking product cost through a POC cost group. Each DPO group has a Product Cost Manager (PCM) assigned to it. Although PCMs are technically in the POC cost group, they report indirectly to their respective DPO. PCMs track the aggregate product cost of the BUs assigned to their DPO to make sure BU cost targets are being achieved. Figure 5 shows the relation between the PCMs in Product Operations Central and the DPO BU sub-groups.

Figure 5: Relationship between PCM and DPO



Product Operation’s first responsibility is to transition a product from the CDO into sustained production at the contract manufacturer. In this role, Product Operations acts as the main interface between the CDO BUs and manufacturing. NPPMs and NPIEs work closely with the BU’s engineering product development team to mitigate risks as a product heads towards production, perform DFM analysis, and assess supplier and CM capabilities. Additionally, after a product has entered into full volume production, Product Operation’s second responsibility is to ensure an acceptable level of product cost and quality for the remainder of a product’s lifecycle.

3.2 New Product Introduction at Cisco

New product introduction (NPI) is Cisco’s core competency and reason that it enjoys its dominant position in its industry. This section discusses the Cisco product development process.

3.2.1 NPI Process and Product Lifecycle

Cisco follows a phase gate product development model that that has roots in a well developed product development framework such as the ones detailed by R. G. Cooper (2001, p. 129) and Ulrich and Eppinger (2004, p. 9). There are seven gates in Cisco’s NPI process: Concept Commit, Execution Commit, Prototype Build, Pre-Pilot Build, Pilot Build, First Customer Ship

(FCS), and Total Time to Quality and Volume (TTQV). After TTQV, the product lifecycle continues in what is called the “sustaining” phase until End of Life (EOL). The typical post-FCS lifecycle is seven years.

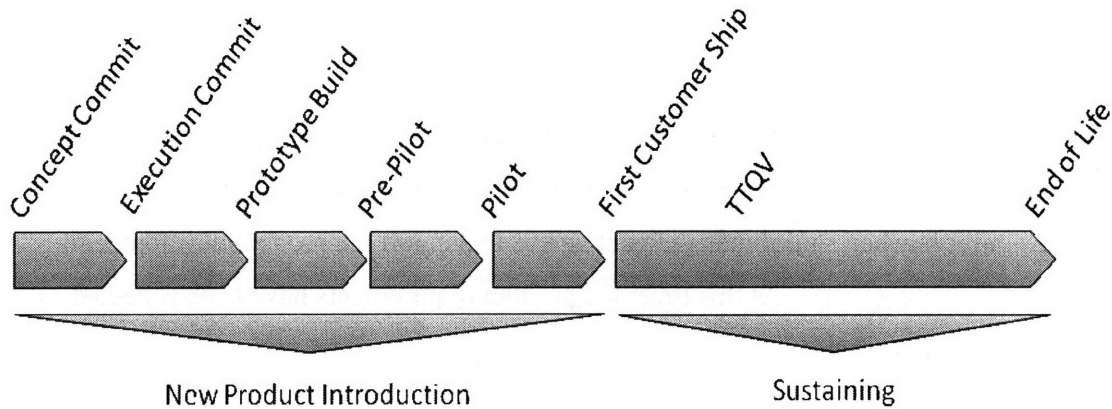
Concept Commit is when the CDO BU product marketing function presents engineering with a set of customer requirements for a new product through a Product Requirements Document. Execution Commit is when senior management agrees to support the product development through funding and resources. At this time, the product requirements have been reflected as engineering requirements.

The next phase of development is prototype builds. Cisco Manufacturing and the contract manufacturers start prototyping the product. This phase serves as the main testing and design change phase of a product development.

The pre-pilot build is the last prototype build and is designed to test out the final production process. Pilot build is the first production build. Following the pilot build is First Customer Ship when the product is first delivered to waiting customers. The product is then ramped to TTQV at which point it becomes the responsibility of the Manufacturing Operations team for the remainder of sustained production, although product-specific issues, such as cost and quality, remain the responsibility of the Product Operations group.

Through FCS, a product is considered in the NPI phase of the product lifecycle and responsibility for the product rests with the BU engineering team. It should be noted however that Cisco Manufacturing, especially Product Operations, has a large involvement in the development. After FCS, the product is considered in the sustaining phase of the product lifecycle and responsibility for the product rests with Cisco Manufacturing, although CDO engineering expertise is often needed for various activities. Figure 6 shows a linear timeline of a Cisco product lifecycle.

Figure 6: Cisco Product Lifecycle



Note: Timeline not to scale

3.2.2 *Mx Initiative*

Cisco Manufacturing is currently in the final stages of a Manufacturing Excellence (Mx) Initiative. The Mx initiative aims to position Cisco as “...the undisputed leader in supply chain management, guaranteeing Cisco’s sustained innovation and competitive advantage.” Although Mx is a Manufacturing driven initiative, many of the processes created through Mx require the involvement of the CDO BUs.

The Mx initiative is comprised of six focus areas. One of these focus areas is Mx NPI. The Mx NPI focus area is driven by the Product Operations group with the mission of delivering “... products to the market that continuously meet the cost, quality, and delivery objectives of the business.” Mx NPI is comprised of four tracks. These are Product Excellence, Supply Chain Design, Management Operating System, and Organizational Readiness. The Supply Chain Design track is further divided into three sub-tracks. The work outlined in this paper was completed under the consideration of one these sub-tracks, Product *Lifecycle Cost Management (LCCM)*. The purpose of the LCCM track is to improve Cisco’s ability to predict and maintain product gross margins.

3.3 Cost in Cisco New Product Introduction

While no product-specific information is available, public Cisco financial information shows that Cisco products collectively deliver healthy gross margins to the firm. Much of this is due to the price that Cisco is able to charge for its technologically superior products. The resulting revenues alone contribute significantly to product gross margins. However, Cisco still must focus on cost as every product development firm must. The extent of which product cost is the focus of new product introduction is often reflective of the business unit. “High Technology” BUs will have less focus on cost as they can charge higher prices for a more differentiated product. “Low Technology” BUs will have a greater focus on cost as they face a more competitive, lower-priced market. Most Cisco products, regardless of BU, are developed under time to market constraints, and cost reduction is often sacrificed. The total value to Cisco of aggressively launching products to market for market share and revenue capture outweighs the value of additional cost reduction effort. This section will introduce Cisco’s cost reduction efforts in product development in light of this context.

3.3.1 Lifecycle Cost Process

As part of the Mx NPI initiative, Cisco implemented a new Product Lifecycle Cost Management process. This LCCM process was created to “predict, track, and achieve lower product costs throughout the lifecycle of any given product.”¹ Cisco product managers use LCCM tools to manage a product’s cost from Concept Commit to End of Life, encompassing both the NPI and sustaining phases of the product’s lifecycle.

At a high level, the LCCM process contributes to Cisco’s overall business goal of preserving gross margins. The LCCM process takes into account several things regarding a product’s margin that enables product managers to incrementally contribute to firm gross margin. First, through BU product marketing input, it sets an initial product target cost by the Concept Commit date of the NPI process that is based on the desired margins of the BU. Second, it establishes target margins for the product to EOL taking into consideration natural deteriorations in prices (often through customer discounts) and COGS. And finally, it recognizes the need for cost

¹ Description from Cisco Lifecycle Cost Management process document

reduction activities throughout the product's lifecycle to meet product margin targets. The Product Operations program manager can use this data to push for cost reduction projects.

The three cost reduction activities stated in the LCCM process are material cost reductions, transformation cost reductions, and value engineering. Value engineering activities occur in the sustaining phase of the product lifecycle and are the focus of this paper. In summary, the LCCM process allows product program managers to actively work to preserve Cisco gross margins on a per product basis by creating clear margin targets for the entire product lifecycle.

4.0 Value Engineering Introduction

As described above, Value Engineering (VE) is one of the tools that Cisco Product Operations uses to reduce the cost of product as part of the Lifecycle Cost Management process. VE originated at General Electric during the 1940s under the tutelage of Lawrence D. Miles. Miles, faced with a wartime shortage of materials, focused attention on a product's function. The goal was to ensure that the product function could be maintained while the specific construction of the product could change. Miles (1972, p. 3) defined value engineering as a "problem solving system....that has for its purpose the efficient identification of unnecessary cost, i.e., cost that provides neither quality nor use nor life nor appearance nor customer features."

A more recent definition of VE is offered by Cooper and Slagmulder (1997, p. 51). VE is a "systematic, interdisciplinary examination of factors affecting the cost of a product with the aim of devising a means to achieve its specified purpose at the required standards of quality and reliability and at an acceptable cost." Cooper and Slagmulder (1997, p. 81) further go on to define VE through two simple equations. The first, shown in Equation 1, defines the value of a product to a producer. The second, shown in Equation 2, reflects the value of a product to the consumer. Cooper and Slagmulder also discuss the concept of the product "survival triplet" that consists of three product characteristics that determine its success. These characteristics are cost/price, functionality, and quality. These characteristics represent both the interests of the producer and the consumer with cost (producer) and price (consumer) separated to reflect the viewpoint of each stakeholder. Quality can be thought to be included in the "Function" and "Perceived Benefits" of the respective equations.

Equation 1: Product Value for a Producer

$$\textit{Value} = \textit{Function}/\textit{Cost}$$

Equation 2: Product Value for a Consumer

$$\textit{Perceived Value} = \textit{Perceived Benefits}/\textit{Price}$$

Value engineering has gained a strong foothold in industry, especially in industries that rely on extensive funding through government contracts such as construction and defense. In fact, the National Defense Authorization Act of 1996 outlines in law value engineering requirements for defense procurement. This act defines VE as “an analysis of the functions of a ...project...directed at improving performance, reliability, quality, safety, and lifecycle costs.”

This section explored existing documentation on VE. The next section will analyze VE specifically to Cisco.

4.1 Value Engineering Definition at Cisco

Value Engineering at Cisco refers to product cost reduction activities that occur during the sustaining part of the product lifecycle that require engineering resources. As previously mentioned, the sustaining part of the product lifecycle is the period between First Customer Ship and product End of Life. This definition of VE causes differences between Cisco’s view of VE and VE as it is commonly interpreted. Most VE sources, including Cooper and Slagmulder (1997) consider VE to be a tool used primarily in the NPI phase rather than the sustaining phase. In further work, Cooper and Slagmulder (2004) go on to define “product-specific kaizen costing” as a process for reducing product costs during the manufacturing (sustaining) phase of the product lifecycle. This description of product specific kaizen costing is strikingly similar to value engineering as defined by Cisco. Despite the differences in definition, the remainder of this thesis will refer to value engineering under the definition defined by Cisco. Cisco refers to product cost reduction activities during NPI as cost avoidance.

The term engineering resources is a broad term that typically means project funding and headcount requirements. The inclusion of the term engineering resources in Cisco’s definition of VE is important as it differentiates a VE project from other product cost reduction activities. For example, simply negotiating a lower price on a commodity is not a VE activity.

Questions often arise as to why there is the need to pursue product cost reductions during the sustaining phase of the product lifecycle. Common thought that must be agreed with is that product cost reduction activities are best conducted during the NPI phase to maximize the

product lifecycle in which the cost savings impacts. However, it has been shown that Cisco meets the three criteria presented at the beginning of this thesis that justifies the pursuit of product cost reduction after product launch.

- Cisco has a significant business reason to forego product cost reduction efforts in the NPI phase of the lifecycle. Cisco operates in a fast product clockspeed industry where time to market is often more valuable than rigorous product cost reduction during NPI.
- The typical seven year lifecycle of Cisco's products after FCS is long enough to allow time to complete a VE project and for savings to result from the project that provide a positive financial return.
- Cisco's product market justifies a product cost reduction project. Cisco does have opportunities to sell its product at prices that will guarantee savings after a VE project is complete.

Cooper and Slagmulder (2004, p. 49) explore this pursuit of cost reduction during the sustaining phase of the product lifecycle through a case study of Olympus Optical, whose camera products have a shorter market lifecycle (12 – 18 months) than that of Cisco products. They found that, “cost reduction in the manufacturing phase was significant source of savings even when aggressive cost management had occurred in product design.” In reference to the survival triplet, Cooper and Slagmulder (2004, p. 47) state that for product cost reduction activities during the sustaining phase, “the primary rule was that the product's functionality and quality has to remain constant.” This is indeed the case at Cisco. Cisco VE is only concerned with reducing the cost of products, while maintaining, at minimum, the existing levels of functionality and quality. Value, as defined by function divided by cost, should increase, as function is unchanged and cost decreases.

4.2 Cisco's Value Engineering Journey

Value Engineering occurs during the sustaining period of the product lifecycle and is product specific, thus, it falls under the auspices of the Worldwide Manufacturing Product Operations. Examples of Cisco VE projects include:

- PLD to ASIC Conversion – A Cisco product is often manufactured initially with a programmable logic device (PLD) which allows for update in the field as the product code is adjusted for refined customer requirements. After some time, after the product is stabilized and updates are no longer needed, the PLD can be replaced by a less expensive application specific integrated circuit (ASIC).
- PCB Layer Reduction – This project involves reducing the layers on a printed circuit board (PCB). Engineering effort is required to fit the same PCB content on fewer layers.
- Alternate Source – This project involves sourcing a component from a second-source or a different source completely. Often alternate sourcing projects require engineering resources to qualify the new supplier, thus defining them as a VE project.

A typical VE project for a specific product can include several different feasible VE ideas. An example of a VE project for a phone product in Cisco's Internet Protocol Communications Business Unit demonstrates this. The project includes a PCB layer reduction, the use of a less expensive connector for the liquid crystal display, and the elimination of a protection diode in the circuitry.

The next sections will explore several key aspects of Cisco's current Value Engineering program.

4.2.1 Director VE Savings Goals

At a high level, Cisco's VE program is driven by VE savings goals assigned to each Director of Product Operations (DPO). As mentioned earlier, the Cisco Product Operations group is comprised of nine DPOs who each lead groups that interact with the CDO BUs. Each DPO is responsible for one or more BUs from a product operations standpoint. One of the DPO's responsibilities is to meet VE savings targets for their BUs. Each fiscal year, Product Operations senior leadership creates a VE savings goal for the entire Product Operations group. This target is then divided down to individual BU VE savings targets. These BU targets are based on each BU's commodity spending level, overall project pipeline, and VE project forecast. This goal setting is a two-way communication between the DPOs and Product Operations senior leadership. DPOs provide input on the state of business in their respective BUs and leadership

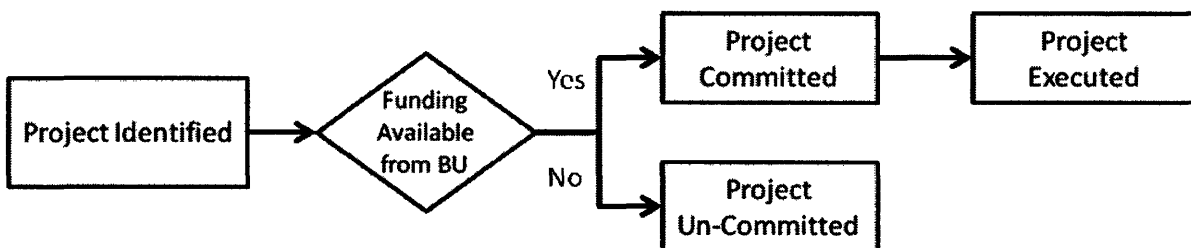
considers this input in light of the overall goals. The end result is a VE savings goal for each BU that is agreed upon by both the DPO and Product Operations leadership. This goal is also correlated with the senior vice-president of Cisco Worldwide Manufacturing.

This goal setting process is analogous to a process that P&L units follow when determining their profit “numbers” for the year. The DPO’s organization thus acts like a pseudo micro profit center mentioned by Cooper and Slagmulder (1997, p. 57). The DPO’s “number” is the VE savings target that eventually reflects on the bottom line of the respective CDO BU (the actual profit centers of Cisco). DPOs report their VE savings numbers to Product Operations senior leadership on a monthly basis and are evaluated on their success in meeting their number in their yearly performance reviews. DPOs motivate their staff throughout the year to meet these targets.

4.2.2 Current Cisco VE Process

Cisco’s VE program starts through motivating each Product Operations group to meet its savings targets. These savings targets are achieved by executing VE projects for individual products that yield savings. At a high level, the original Cisco VE process for committing a VE project is shown in Figure 7. A VE project’s funding primarily comes from the CDO BU responsible for the product. In very rare cases, project funding can come through the DPO’s own budget. If a project receives funding, it is considered committed and engineering work begins. If funding for the project is unavailable, the project is considered un-committed.

Figure 7: Cisco Value Engineering Process



Cisco VE performance by BU is tracked by a VE Program Manager within the Product Operations Central cost group. The VE Program Manager tracks BU committed savings against

target savings and facilitates meetings between VE stakeholders. The Product Operations Central cost group has also assigned VE Leads in each DPO group and implemented a VE Checklist to aid the DPO groups in meeting their VE targets.

4.2.2.1 VE Leads and the VE Checklist

A member of each DPO group is designated as that group’s VE Lead. The VE Lead is responsible for conducting group brainstorming sessions on regular basis to identify new VE projects for the BU, ensuring that ongoing VE projects are executed as planned by program managers, and reporting BU VE savings information to the VE Program Manager. The VE Program Manager organizes regular meetings with the VE Leads to communicate the latest information regarding Cisco VE, such as automated reporting, targets for upcoming fiscal years, and important reporting deadlines.

To spur the growth of VE ideas throughout Product Operations, a checklist of VE ideas was created to aid VE Leads in identifying projects for their BUs, especially during idea brainstorming sessions. This checklist, although homegrown, is similar to the one proposed by Bhat (2005, p. 27). This checklist is not an exhaustive list of VE ideas but rather a list of common VE ideas that should be considered for each product. The checklist adds some structure to creative brainstorming sessions. The VE Checklist is divided into three areas of VE: engineering, supply chain, and transformation (production). Examples of VE Checklist items are shown in Figure 8.

Figure 8: Examples of VE Checklist Items

VE Area: Engineering
1. Did you consider a PLD to ASIC conversion?
2. Did you consider simplification of mechanical design for the following?
a. Did you consider using the most cost-effective material?
b. Did you consider using common (industry standard) metal thicknesses?
c. Did you consider not using paint on non-visible parts?
d. Did you consider consolidating labels, or replacing a label with stamped characters?
VE Area: Supply Chain
1. Did you consider alternate sourcing for the following?
a. Printed Circuit Board
b. Power Supply
VE Area: Transformation
1. Did you consider tooling (soft tool to hard tool) conversion?

4.2.3 Closing the Gap

As mentioned, every month each DPO reports the status of their BUs' VE savings targets to Product Operations senior leadership. The DPO presents the current achievement towards the target via completed projects and the committed projects that are on the roadmap that will help "close the gap" towards the target. The DPO also presents uncommitted projects. These are new projects that have yet to be committed or older projects that have been removed from the commit list. These projects could contribute positively towards meeting the savings goal if they could be permanently committed.

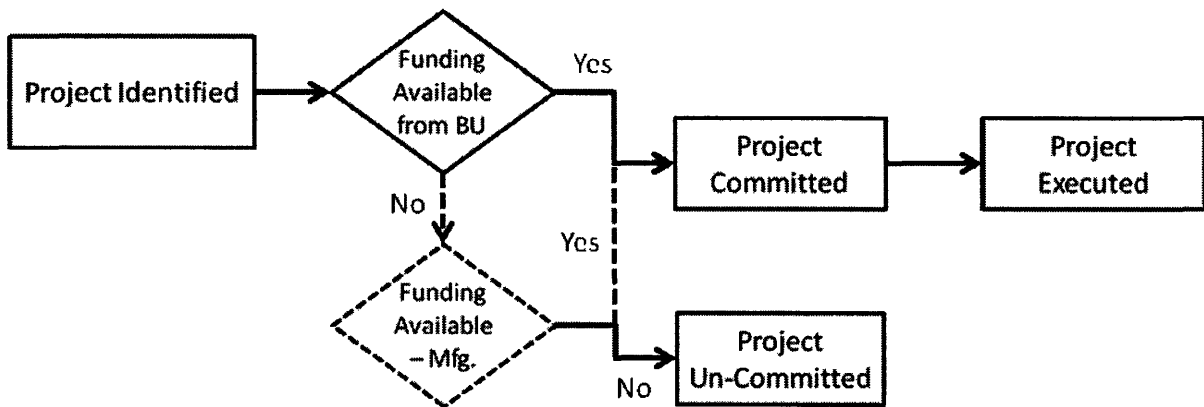
A common reason that projects cannot be committed initially or have stopped being pursued is that the funding for them is not available. This highlights an overall improvement opportunity for Cisco's VE process. Cisco VE projects are funded primarily by the CDO BUs. DPOs encourage, track, and are accountable for VE savings but ultimately do not have the power to commit a VE Project through funding. Since Cisco is a firm that must consistently develop new products, NPI projects will receive preference to VE projects in CDO budget allocation. If the DPOs had an additional source of funding for VE projects that did not have to compete with NPI, more VE projects could be committed. A recent analysis of uncommitted projects showed 240 uncommitted projects across 20 business units that could yield \$154 million in potential savings. If additional funding was available to commit more projects, considerable savings could clearly be delivered to Cisco.

5.0 New Value Engineering Process

Cisco's current business climate supports a VE effort as Cisco defines it: pursuing product cost-reduction activities after FCS that utilize engineering resources. Cisco also has established VE capabilities from which to expand on. The key pain point that is present among the DPOs accountable for VE savings is that often there are not sufficient CDO BU resources to commit some VE projects that have been identified.

A hypothesis was established that Cisco could realize additional VE savings if uncommitted projects could receive funding from a source other than the CDO BU budget. Establishing a process from which projects could receive funding directly from Cisco Worldwide Manufacturing is such a way to fund uncommitted projects. Establishing such a process would create another path to "project committed" as shown by the dashed process flow in Figure 9. The development of this process is the focus for the remainder of this thesis.

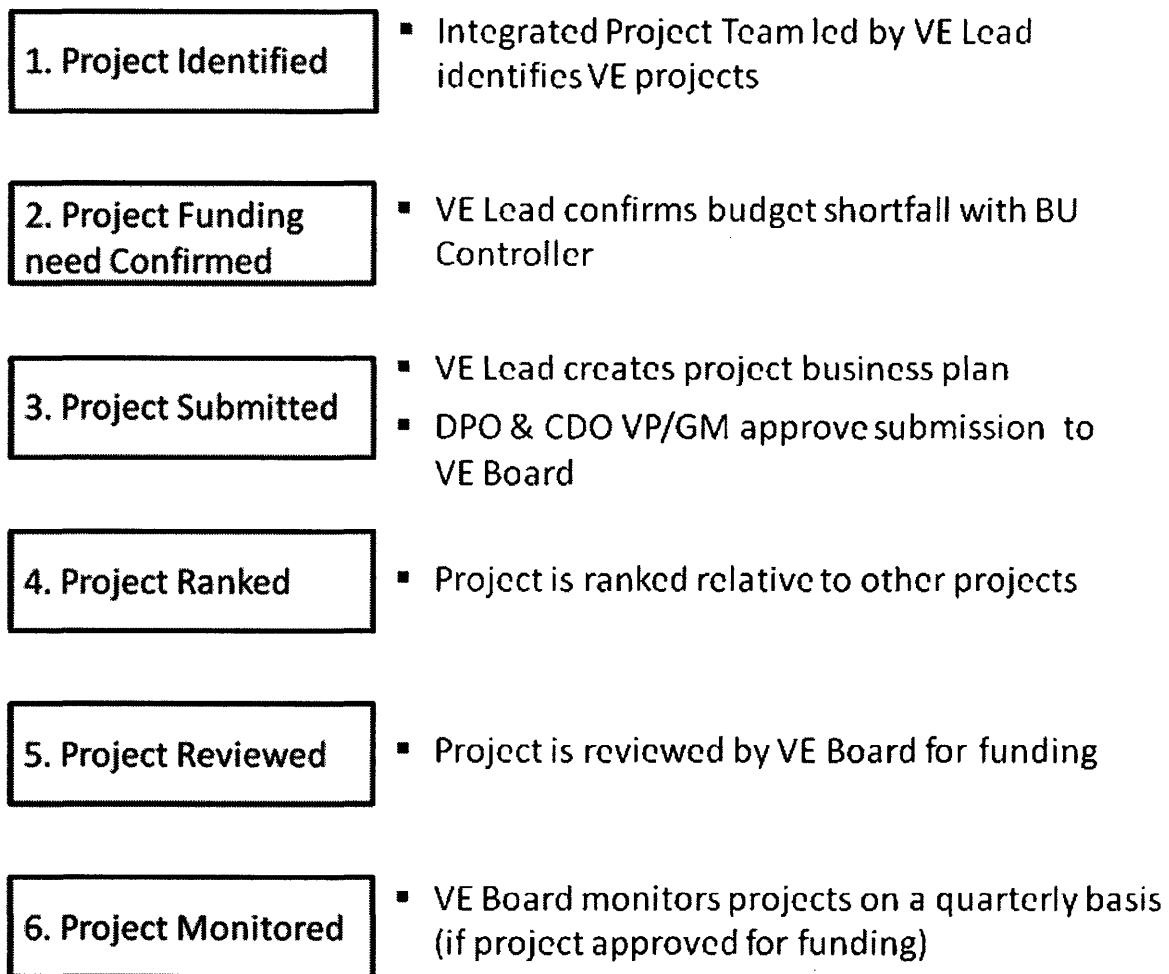
Figure 9: Cisco Value Engineering Process with Additional Funding Path



It should be noted that this process is intended to provide incremental funding to VE projects through Manufacturing. Incremental funding is funding that closes the gap between the funds that the BU has available for the project and the total funds that the project needs to be committed. As with other types of corporate funding issues, if Manufacturing were to obtain funds with which to incrementally fund VE projects, it would likely not be able to fund every

project available. Decisions would have to be made on which projects to fund and a level of due diligence would be needed to ensure that funded projects did indeed predict and eventually deliver a positive financial return. A process would be needed to award these funds to appropriate projects and monitor the projects' status. Figure 10 is an overview of the process that was developed to accomplish this. This funding process is executed once per quarter to award funding to projects.

Figure 10: Process to Allocate VE Project Funding Through Manufacturing



The process steps in Figure 10 are detailed in the following sections. Process specific terms, such as VE Board, will be detailed in these sections.

5.1 Projects Identified

Integrated Product Teams led by the VE Lead from Product Operations identify VE Projects for their representative CDO BU. This first step is not all that different than the existing Cisco VE process. The IPT then determines which projects can be committed through available BU funds and which projects do not have sufficient funding, thus remaining uncommitted. Although the VE funding process is executed on a quarterly basis, the identification of projects is likely to be an ongoing activity of the IPTs. When project ideas are identified, the VE Leads will then take it through the process at the earliest available opportunity.

5.2 Budget Controller Confirms Budget Shortfall

In the next phase of the process, the VE Lead confirms with the CDO BU Budget Controller that there are insufficient funds to commit the project. This step ensures that the BU is fully aware of the positive financial return that the project presents before deciding not to commit the project through its own funding.

5.3 Project Submitted



After the CDO BU Controller confirms that the BU does not have funds to submit the project, the BU VP/GM and the DPO can decide if they want to submit the project for incremental VE funds through the Manufacturing funding process. If they decide to submit the project, the VE Lead coordinates the completion and submission of a Project Business Plan. The Project Business Plan includes all of the information that will be used in process step 4 to rank the project relative to other submitted projects and in process step 5 when the VE Board makes project funding decisions. After the Project Business Plan is complete, the VE Lead submits it to the VE Program Manager so that the project ranking can be compiled.

5.3.1 VE Project Business Plan



The VE Business Plan is a Microsoft Excel document. The blank template is available to the VE Leads on a local shared network drive. Upon opening the Excel file, the business plan spreadsheet will appear as shown in Figure 11. There are two kinds of shaded cells, commit cells (shaded blue in the original file) and expected cells (shaded yellow in the original file).

1. Commit cells - These cells must be filled in prior to the VE Board Meeting in which the project is first proposed for funding. These are labeled the commit values.
2. Expected Cells - For projects that receive funding from the VE Board, these cells are filled in for future VE Board Meetings to update the Board on the expected status of the project against its commit (blue cells at time of funding). These are the expected values. Expected cells are not filled in for the first VE Board Meeting in which the project is proposed for funding.

Figure 11: VE Business Plan Template

Note: Blue Cells Shaded as Follows 
 Yellow Cells Shaded as Follows 

VE Business Plan

Technology	BU	Project Name	Ranking	#												
Financials		Operations														
1. Summary		5. Project Team														
Incremental Non-HC* Investment Asked/Awarded (\$K)		<table border="1"> <thead> <tr> <th>Role</th> <th>Name</th> </tr> </thead> <tbody> <tr> <td>Project Manager</td> <td></td> </tr> <tr> <td>DPO</td> <td></td> </tr> <tr> <td>CDO VP/GM</td> <td></td> </tr> </tbody> </table>			Role	Name	Project Manager		DPO		CDO VP/GM					
Role	Name															
Project Manager																
DPO																
CDO VP/GM																
Incremental HC* Investment Asked/Awarded (\$K)		*Non-HC includes Prototypes, NRE, & CM/Outside Srvc. *HC includes CDO HC and Mfg. HC														
Total Incremental Investment Asked/Awarded (\$K)	\$	-														
	Commit	Expected														
1-Year Savings (\$K)				Mfg. Fin.												
ROI % (1 year sav./ total inv.)				Mfg. Fin.												
NPV (3 years) (\$K)				Mfg. Fin.												
Cut-In Date (month/year)																
2. Project Investment Detail		6. Project Description														
\$ in thousands	Project*	Incremental	Notes													
Prototypes																
NRE																
CM/Outside Srvc.																
CDO HC																
Mfg. HC																
Total	\$	\$														
CAPEX																
* Total Investment Required for Project in Each Category																
3. Incremental Investment and CAPEX by Quarter		7. Project Dates														
\$ in thousands	Q208	Q308	Q408	Q109	Q209+											
Non-HC (commit)*																
HC (commit)*																
CAPEX (commit)																
Non-HC (expected)																
HC (expected)																
CAPEX (expected)																
4. Savings Forecast		8. Project Risk														
\$ in thousands	FY08	FY09	FY10	FY11	FY12											
Units																
Investment																
Savings																
		<table border="1"> <thead> <tr> <th>Event</th> <th>Commit Date</th> <th>Expected Date</th> </tr> </thead> <tbody> <tr> <td>Concept Commit</td> <td></td> <td></td> </tr> <tr> <td>Execution Commit</td> <td></td> <td></td> </tr> <tr> <td>Cut-In</td> <td></td> <td></td> </tr> </tbody> </table>			Event	Commit Date	Expected Date	Concept Commit			Execution Commit			Cut-In		
Event	Commit Date	Expected Date														
Concept Commit																
Execution Commit																
Cut-In																
		<table border="1"> <thead> <tr> <th>Risk Sub-Area</th> <th>Score 0-4</th> </tr> </thead> <tbody> <tr> <td>Technical Risk</td> <td></td> </tr> <tr> <td>Savings Risk</td> <td></td> </tr> </tbody> </table>			Risk Sub-Area	Score 0-4	Technical Risk		Savings Risk							
Risk Sub-Area	Score 0-4															
Technical Risk																
Savings Risk																
		*Non-HC includes Prototypes, NRE, & CM/Outside Srvc. *HC includes CDO HC and Mfg. HC														
		Cell Legend														
		 Fill in prior to original VE Board Mtg  Fill in prior to each VE Board Mtg. Update with updated numbers														

5.3.2 VE Business Plan Sections

The VE Business Plan is broken down into the eight sections listed below. These sections along with the data that is input into them will be described in detail in the following sections.

1. Summary
2. Project Investment Detail
3. Incremental Investment by Quarter
4. Savings Forecast
5. Project Team
6. Project Description
7. Project Dates
8. Project Risk

5.3.2.1 VE Business Plan Sections: Summary

The summary is intended to present the most important information about the project to the VE Board. The following items are entered:

1. The non-headcount incremental investment the project team is requesting (if the project receives funding, this amount will become the awarded amount). Non-headcount investment refers to items such as non-recurring engineering expenses, prototype expenses, and payments to contract manufacturers or outside service firms.
2. The headcount incremental investment the project team is requesting (if the project receives funding, this amount will be the awarded amount). Headcount investment refers to headcount costs associated with both Cisco CDO and Cisco Manufacturing engineers whose time is required to complete the project.

From the above two numbers, the template will then calculate the total incremental investment the project team is asking for.

The manufacturing finance representative assigned to each DPO group will then calculate the following information for the summary.

3. The 1-year savings that the project will deliver. This is the savings that the project will deliver in the first year after it is completed.
4. The project's return on investment (ROI) as a decimal. The ROI is defined as the 1-year savings divided by the total project investment.
5. The project net present value (NPV) over three years. Cisco products have an average lifecycle of seven years. Product sales volumes are typically stronger and more stable in the few years after FCS and taper off later in the product lifecycle. In light of this, three years is considered an appropriate length of time in which to calculate NPV.
6. The project cut-in date (month/year). The cut-in date refers to the date when the savings from the project start to be realized through product sales.

The summary section of the VE Business Plan template is shown in Figure 12.

Figure 12: VE Business Plan Summary Section

1. Summary

Incremental Non-HC* Investment Asked/Awarded (\$K)			*Non-HC includes Prototypes, NRE, & CM/Outside Srvc.
Incremental HC* Investment Asked/Awarded (\$K)			*HC includes CDO HC and Mfg. HC
Total Incremental Investment Asked/Awarded (\$K)	\$		-
	Commit	Expected	
1-Year Savings (\$K)			Mfg. Fin.
ROI % (1 year sav./ total inv.)			Mfg. Fin.
NPV (3 years) (\$K)			Mfg. Fin.
Cut-In Date (month/year)			

5.3.2.2 VE Business Plan Sections: Project Investment Detail

This section breaks down the project investment into five areas.

1. Prototype Expenses
2. Non-Recurring Engineering Expenses (NRE)
3. Contract Manufacturer/Outside Service Payments (CM/Outside Srvc.)
4. Cisco CDO Engineering Headcount Expenses
5. Cisco Manufacturing Headcount Expenses

The investment needed for each area is entered into the appropriate cell. There are two columns for each investment category. They are labeled “project” and “incremental.” The “project” column is the investment in each category that the project needs in total. The “incremental” column is investment for each category that the project needs to commit the project in addition to the investment that is available from the CDO BU. The incremental investment is the funding that the project team is requesting from the VE Board. Explanations of the investment amounts can be entered in the “notes” column. An example of this would be “Payments to Partner A” in the Contract Manufacturer/Outside Service Payments category.

After investment is entered in each category, the spreadsheet calculates the total project and total incremental investment. The total incremental investment in this section matches the total incremental investment in the summary section.

The required project capital expenditures (CAPEX) must also be entered in this section. An example of project CAPEX would be test fixtures. The VE Board cannot fund CAPEX so it is not included as part of the project investment. However, this information is required for manufacturing finance tracking purposes.

The project investment detail section of the VE Business Plan template is shown in Figure 13.

Figure 13: VE Business Plan Project Investment Detail Section

2. Project Investment Detail

\$ in thousands	Project*	Incremental	Notes
Prototypes			
NRE			
CM/Outside Srvc.			
CDO HC			
Mfg. HC			
Total	\$ -	\$ -	
CAPEX			

* Total Investment Required for Project in Each Category

5.3.2.3 VE Business Plan Sections: Incremental Investment by Quarter

This section details the incremental investment and capital expenditures (CAPEX) the project needs by fiscal quarter. Three categories are tracked.

1. Non-Headcount Investment – this includes prototypes, NRE, and contract manufacturer/outside service payments from Section 2
2. Headcount Investment – this includes Cisco CDO headcount and Cisco Manufacturing headcount from Section 2
3. Capital Expenditures

The amount from each category that the project needs for the four quarters following the VE Board meeting in which the project is awarded funding and for the duration of the project is entered into the table. This section in a sense divides the funding information from Section 2 by quarter.

The rows labeled “commit” contain the projected required investment by fiscal quarter at the time project funds are being requested from the VE Board. If the project is awarded funding, this funding schedule becomes the quarterly budget which the project team can draw against. The rows labeled “expected” will be filled in with the actual spending against the allocated budget for presentation to the VE Board at subsequent Board meetings.

The incremental investment and CAPEX by quarter section of the VE Business Plan template is shown in Figure 14.

Figure 14: VE Business Plan Incremental Investment and CAPEX by Quarter Section

3. Incremental Investment and CAPEX by Quarter

\$ in thousands	Q208	Q308	Q408	Q109	Q209+
Non-HC (commit)*					
HC (commit)*					
CAPEX (commit)					
Non-HC (expected)					
HC (expected)					
CAPEX (expected)					

5.3.2.4 VE Business Plan Sections: Savings Forecast

The savings forecast section explains how the project will deliver savings through product sales. The product unit sales, project investment, and projected savings are entered for a five-year period. The VE Lead obtains the product forecast data from the BU product marketing team. If exact product forecast data is not available for certain years (ex. year 3), the VE Lead, in conjunction with the product marketing team, should make an educated estimate if possible. If this is not possible, the product forecast, and hence savings should be considered zero for these years and any savings that would result should not be reflected into the project NPV calculations. The savings forecast section of the VE Business Plan template is shown in Figure 15.

Figure 15: VE Business Plan Savings Forecast Section

4. Savings Forecast

\$ in thousands	FY08	FY09	FY10	FY11	FY12
Units					
Investment					
Savings					

5.3.2.5 VE Business Plan Sections: Project Team

This section lists the following, high-level, project stakeholders.

1. Project Manager – The engineer within the Product Operations group who is in charge of the project.
2. Director of Product Operations – The DPO who is responsible for the particular BU that the project represents.
3. CDO VP/GM – The VP/GM from the CDO BU that the project represents

The project team section of the VE Business Plan template is shown in Figure 16.

Figure 16: VE Business Plan Project Team Section

5. Project Team

Role	Name
Project Manager	
DPO	
CDO VP/GM	

5.3.2.6 VE Business Plan Sections: Project Description

A brief project description is entered in this section. The project description is written as if the project were being explained to senior management.

5.3.2.7 VE Business Plan Sections: Project Dates

Key project dates are entered in this section. The concept commit date and the execution commit date are analogous to the events in the Cisco NPI process. Indeed, a VE project is approached in much the same way that an NPI project is. The cut-in date refers to the date when the savings resulting from the project start to be realized through product sales.

The commit dates are entered prior to the VE Board Meeting in which funding is requested. The expected dates are entered prior to each project update to the VE Board at future meetings. The project dates section of the VE Business Plan template is shown in Figure 17.

Figure 17: VE Business Plan Project Dates Section

7. Project Dates

Event	Commit Date	Expected Date
Concept Commit		
Execution Commit		
Cut-In		

5.3.2.8 VE Business Plan Sections: Project Risk

VE Leads, with input from the Integrated Project Team, rank two risk factors related to a VE project. These risk factor rankings give the VE Board an idea of how likely the project is going to deliver the projected financial return. There are two types of risk associated with a VE project: technology risk and savings risk. These risks represent circumstances that could cause a project to endure a cut-in delay or cancellation, resulting in less projected savings. The two risk ratings will impact the project ranking that will be discussed in the next section.

The technology risk is a rating of how likely the technological complexity of the project is likely to cause a delay. For example, the project could be the first time that Cisco engineers have attempted something that resembles the work involved in undertaking the project. A project is assigned a technology risk numerical rating according to the scale in Figure 18.

Figure 18: Technology Risk Rating Scale

Rating Scale	0	1	2	3	4
Technology Risk	No technology risk, well understood implementation path	Minimal technology risk	Some technology risks and qualification define schedule	Technology risks/hurdles define schedule	Major technology risk with likelihood of extended delays

The savings risk is a rating of how likely the project is to fail to achieve its calculated savings due to changes in the product sales forecast. The savings risk associated with this is ranked by the VE Lead, with input from the IPT and Product Marketing. A project is assigned a savings risk numerical rating according to the scale shown in Figure 19.

Figure 19: Savings Risk Rating Scale

Rating Scale	0	1	2	3	4
Savings Risk	Low likelihood to not meet savings	>	Med. likelihood to not meet savings	>	High likelihood to not meet savings

The project risk section of the VE Business Plan template is shown in Figure 20.

Figure 20: VE Business Plan Project Risk Section

8. Project Risk

Risk Sub-Area	Score 0-4
Technical Risk	
Savings Risk	

5.4 Project Ranked

After the project business plans have been submitted, the VE Program Manager creates a ranking of the projects. This ranking is compiled to give as unbiased a view as possible of a project’s value relative to that of other submitted projects to the VE Board. This section will describe the ranking criteria, ranking formula, and ranking results.

5.4.1 Project Ranking Criteria

Projects are ranked on the four criteria that are collected from the project’s business plan. The first two criteria act as positive contributors to a project’s ranking. They are the short-term

financial return (1-year ROI from the project business plan) and the total financial opportunity (3-year NPV from the project business plan).

The next three ranking criteria act as negative contributors to a project’s ranking. They are the Technical Risk Rating, the Savings Risk Rating, and the Cut-In Rating. The Technical Risk Rating and Savings Risk Rating are obtained from the project business plan and have been described in that section. The Cut-In Rating is a score that is determined based on the project’s cut-in date for savings. The project is assigned a rating based on the number of quarters from the date of the VE Board review that a project’s savings cut-in. The cut-in rating affects the project ranking in a negative manner because the further out a project’s savings will be realized; the less valuable it is to Cisco. This cut-in rating system is shown in Figure 21.

Figure 21: Cut-In Rating Scale

Rating Scale	0	1	2	3	4
Cut-In Qtrs. from VE Board Review	1	2-4	5-6	7-8	> 8

5.4.2 Project Ranking Formula

This section will present the formula that is used to give the project its project ranking number and give an example of how a project ranking number is calculated using the formula. The project ranking formula is shown in Equation 3.

Equation 3: VE Project Ranking Formula

$$\text{Project Ranking} = \text{ROI} + \frac{\text{NPV}}{1,000,000} - \text{Technical Risk Rating} - \text{Savings Risk Rating} - \text{Cut in Rating}$$

There are some specific things that should be noted about the ROI and NPV inputs. The ROI is input as a decimal. The NPV is divided by \$1 million. This “normalizes” the ROI and NPV numbers relative to each other. This will be clear in the next ranking example.

5.4.3 Project Ranking Example

This section will give an example of the ranking for a hypothetical VE project that is requesting incremental funding from the VE Board: Project X. Suppose Project X has the following ranking inputs:

- 1-year ROI: 4.4
- 3-year NPV: \$6,000,000
- Technical Risk Rating: 3
- Savings Risk Rating: 1
- Cut-in Rating: 1 (this means that the project savings cuts in between 2 and 4 quarters from the date of the VE Board Review)

Note: The information in the above chart has been adjusted to protect confidentiality.

The project ranking score would thus be as shown in Equation 4. Notice that the ROI is a decimal and the NPV is divided by \$1 million.

Equation 4: VE Project Ranking for Hypothetical Project X

$$\text{Project Ranking} = 4.4 + \frac{6,000,000}{1,000,000} - 3 - 1 - 1$$

$$\text{Project Ranking} = 5.4$$

5.4.4 Project Ranking Results

After all projects have been submitted for review by the VE Board, the VE Program manager compiles a list of projects ranked according to their ranking number. A disguised list of projects

is shown in Figure 22. Project data that are entered by the VE Leads in the business plan are shown in the table and the Project Ranking Score is at the far left. The VE Board will use these rankings as a guide when making its funding decisions.

Figure 22: List of Projects by Project Ranking Number

	Project	BU	Cut-In	Inv. NRE \$K	Inv. HC \$K	Savings \$K	ROI	NPV \$M	Technical Risk	Savings Risk	Cut-In	Final Score
1									1	0	1	14.0
2									1	0	4	11.3
3									3	2	1	7.5
4									1	2	1	7.2
5									3	0	1	6.0
6									3	4	4	5.3
7									1	0	2	2.0
8									3	2	2	1.2
9									3	0	1	-0.1
10									1	4	3	-2.7

Note: The information in the above chart has been adjusted to protect confidentiality.

5.5 Project Reviewed

Once a project has been ranked, it is presented along with the other submitted projects to the Value Engineering Board for a funding decision. The VE Board will either choose to fund the project through the Manufacturing VE budget or not fund the project. The VE Board will make its funding decision based on the project’s ranking, and the business knowledge that Board members have of the project. If a project receives funding, the appropriate DPO will be notified and Manufacturing Finance will create a budget code for the project to charge against as work begins.

5.5.1 Value Engineering Board Members

The VE Board is a cross-functional group of executives that represent functions from across Cisco. This cross-functional representation on this decision making body is critical so that funding decisions seem unanimous within Cisco and well thought out from all functional angles. The membership of the VE Board includes nine members listed in Figure 23. This membership provides a high-level, cross-functional representation of Cisco from Manufacturing, Finance, and CDO, including General Managers of the core routing and switching business units. There is the possibility of updating the VE Board in the future as business needs dictate.

Figure 23: VE Board Members

Facilitator, Sr. Manager of Product Operations (Manufacturing)
2 Vice-Presidents of Product Operations (Manufacturing)
Vice-President of Global Supply Management (Manufacturing)
Sr. Director Finance (Manufacturing)
Vice-President Finance (Business Operations)
Vice-President Engineering (CDO)
Vice-President/General Manager Routing (CDO)
Vice-President/General Manager Switching (CDO)

5.6 *Project Monitored*

Once a project has received funding from the VE Board, the VE Lead will provide a project status update to the Board at subsequent quarterly board meetings. The VE Lead will update the project's financial and cut-in information as well as give an update on the use of funds that the project was awarded. This information is input in the expected cells (yellow) of the VE Project Business Plan. The VE Board will then decide whether to continue funding the project or to cancel the project based on under performance.

6.0 Results

The process outlined in Chapter 5 was designed as a feedback loop to get VE projects from uncommitted status to committed status after they had initially been denied funding with the hypothesis that more VE savings would result. This process was implemented at Cisco from June through December 2007. This implementation can be thought of as a pilot effort.

6.1 Submission of Projects

As part of this pilot effort, 11 projects in need of incremental funding were submitted using the VE business plan presented in Chapter 5. These projects represented seven different Cisco CDO business units that were chosen to participate in this pilot. For this pilot effort, Product Cost Managers (PCM) in the Product Operations Central group rather than VE Leads completed business plans for their respective BUs. Working with the PCMs to complete the first round of business plans provided a cohesive group from which to receive feedback on the business plan template and the process. Business plan submissions were facilitated through the use of a shared group network drive folder. PCMs would access the folder to retrieve the blank business plan template and submit the completed template to the folder under a filename representing the project. Once all of the projects had been submitted, they were ranked according to the developed methodology.

6.2 Results of VE Board Meeting

The first quarterly VE Board meeting was held in November 2007. The board reviewed the business plans of submitted projects and the project rankings. Because this was the initial meeting, there were no projects that had already received funding that needed review by the Board.

6.2.2 Project Funding Results

At the initial VE Board meeting, the Board funded four of the submitted projects through its Manufacturing VE Budget. These projects represented four different Cisco business units. The return on investment for these projects was 740%. Although none of the savings will be incurred in fiscal year 2008, this savings does represent 9% of Cisco's 2008 VE savings goal. As these funded projects were projects that would have remained uncommitted, the results of this initial

Board meeting indicate that a Manufacturing VE budget allocation will increase Cisco VE savings.

6.2.3 Process Results

Overall feedback on the VE incremental funding process was positive. Following the initial VE Board meeting, the incremental VE funding process was rolled-out to the VE Leads within the Product Operations group. The VE Leads would be responsible for VE Business Plan submission at all subsequent VE Board meetings. At the subsequent quarterly VE Board meeting, the VE Board continued funding for all four projects that were approved at the inaugural meeting.

One of the critical elements of the VE funding process was the cross-functional nature of the VE Board. This provided an informal way for Manufacturing to evangelize manufacturing led VE efforts. The benefits of this cross-functional nature were best summarized by a Manufacturing VP on the VE Board. He pointed out that the VP/GMs of routing and switching rarely talked with each other, yet alone about VE, but they did at the Board meeting.

7.0 Process Improvement and Opportunities for Additional Saving

The incremental VE Funding process outlined in this thesis has the potential to provide sustained, additional VE savings to Cisco. This section will outline improvements that can be made to this process. It will also outline opportunities through which additional VE savings could be realized.

7.1 Improvements to Newly Established Process

This section will highlight opportunities for improvement to the VE funding process described in this thesis.

7.1.1 Automation

The incremental VE funding process was implemented in a pilot phase which required much “manual” work on the part of stakeholders. PCMs had to retrieve the Excel business plan template from a shared network drive, complete the business plan, and then submit it back to the same network drive under an identifiable name. This work will now be done by the VE Leads. Further manual work is required of the VE Program Manager. The program manager must compile the project rankings in an Excel document for presentation to the VE Board.

Both the work of the VE Lead and the VE Program Manager can be made easier through automation. A database on which to submit projects would provide a clear and concise method for VE leads to submit their projects. They could fill out fields with appropriate information without having to worry about saving and submitting a separate file. The database could then calculate the project rankings from the information entered by the VE Leads. This would save much manual work on the part of the VE Program Manager.

7.1.2 CDO Involvement

Before this process was implemented, Product Operations had to, at times, “push” VE projects through the CDO BUs in attempts to meet its savings targets. Implementing a process to fund VE Projects through Manufacturing was an effective way to “pull” VE projects. CDO BUs are incentivized to obtain “free” funding that will support projects to help their bottom line. These incentives created awareness amongst CDO for VE efforts being driven by Manufacturing. The

next step would be to solidify this awareness with commitment. CDO BUs could commit to the VE targets assigned to the DPO responsible for that BU. This would create co-responsibility towards VE amongst the CDO and Manufacturing stakeholders. This co-responsibility would act to complete the Integrated Project Teams with representation from CDO engineering and product marketing.

7.2 Improvements for Additional Opportunity

This process was another incremental step in Cisco's journey towards becoming a premier VE firm. Additional steps that can be taken to create more product savings for Cisco are outlined in this section.

7.2.1 Establishing Engineering Capabilities within Manufacturing

The incremental funding process outlined in this thesis assists Cisco business units in funding the headcount of a project if it is needed. The process is designed to fulfill a headcount need through funding alone. The BU still has to make its own plans as how to obtain the actual headcount. Often this headcount comes through engineers in its own organization. However, there could be times when BU engineers are not available to be staffed on VE projects due to a more pressing need. A next step for manufacturing would be to be able to provide the BU with capable engineers to work on projects. This could be done by establishing a specific Manufacturing Value Engineering group containing engineers with the hardware, software, and mechanical engineering skills needed for VE projects.

7.2.2 Leveraging Partners

Quite frequently, Cisco supplier and contract manufacturer partners become involved in VE projects. Expanding partner involvement even further could lead to increased VE savings. Partner resources could be used to supplement Cisco resources to fund and staff VE projects when sufficient Cisco resources are not available. An agreement could then be reached to share the savings of a project between Cisco and the partner. Joint VE projects would also tap the creativity and expertise of partner engineers even more than it already is.

7.2.3 Reflecting VE Learning into NPI

Perhaps the greatest area of additional product savings for Cisco is in leveraging cost saving ideas learned through VE projects into the NPI phase of the product lifecycle. A product's sales are typically higher in the first several years following its launch and decline to end of life. Thus, if product cost reduction ideas can be incorporated as soon as possible in the product lifecycle, savings will be maximized. Cisco Manufacturing should establish a feedback loop to the NPI process so that a VE idea for one product is given consideration during the pre-FCS NPI development of future products. Also, products in the upcoming NPI pipeline could be analyzed for VE ideas that, due to time to market constraints, cannot be incorporated during NPI. This way, manufacturing could kick-off VE efforts for the project as soon as possible after FCS.

7.2.4 Identifying Cross-Product VE Projects

Another opportunity of potentially significant VE savings is through cross-product VE projects. VE ideas that could be implemented across multiple projects would create a ROI that would exceed that of a single-product project as the project investment would be spread over the combined sales of the products, yielding more savings for less investment. To create cross-product VE project opportunities, communication amongst BUs must be encouraged. There is currently some communication amongst BUs, primarily on the Manufacturing side. This communication typically occurs when the DPOs present their BU savings to Product Operations senior management as a group. Specific projects are often discussed and dialogue between the DPOs results. However, to truly foster cross-product idea generation, a more robust knowledge sharing framework is needed. This would best be done through the VE Leads. A scheduled quarterly meeting between VE Leads to discuss how specific projects being undertaken by one BU could affect the products of other BUs would accomplish this. If a cross-product project is identified at these meetings, the VE Leads can establish a plan to combine BU resources to complete the projects efficiently.

To further encourage cross-product projects, these projects can be given some additional consideration in the project rankings that are presented to the VE Board. One way to do this would be to have them submitted as a joint project. By combining projects, the ROI and NPV of the joint project should be greater than that of each individual project, resulting in a higher project

ranking than each project could obtain individually. Also, a policy can be instituted that requires project to be presented to other VE Leads for cross-product opportunities before it can be submitted to the VE Board.

8.0 Conclusion

This thesis focused on establishing a product cost reduction function that focuses on products in the sustaining manufacturing phase of the product lifecycle. Cisco met the three criteria proposed that justified pursuing such a cost reduction effort. Cisco is a company driven by both external forces and internal processes that necessitate innovation. This innovation, while leading to Cisco's dominance of its industry, has often made product cost reduction a secondary priority in new product introduction. It has also left product cost reduction opportunity available during sustained manufacturing.

The value engineering process described in this thesis was established within the Product Operations group of Cisco Manufacturing. The thesis hypothesis was that Cisco could realize additional VE savings if Manufacturing could provide supplemental funding to Cisco Business Units for VE projects that would otherwise not be committed and additional VE savings would result.

A critical aspect of this process was that projects were approved by a cross-functional VE Board comprised of high level executives. This ensured that approved projects received a broad endorsement from all functions that could potentially be involved. The VE Board also offered a platform for Product Operations to promote VE efforts across Cisco through the interaction of the executives at Board meetings. For a firm implementing such a VE process, a collaborative approach between key functions is strongly recommended as VE projects are seldom completed in a silo by one function.

The process described in this thesis was implemented at Cisco as a pilot. The overall results of this pilot were positive. The availability of manufacturing funds for the BU's VE projects did have the intended effect of pulling more projects to committed status. The immediate challenge going forward will be to maintain momentum established from the pilot so that BUs see the benefit of pursuing Manufacturing funds for VE. This should continuously lead to more interaction between CDO and Manufacturing in the realm of product engineering. The process has established a solid foundation from which to further build Cisco's VE capabilities.

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