THE USE OF A PRODUCT END OF LIFE PROCESS TO EFFECTIVELY MANAGE A PRODUCT PORTFOLIO

by
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B.S. Mechanical Engineering, Cornell University, 1989

Submitted to the Sloan School of Management
and the Department of Mechanical Engineering
in Partial Fulfillment of the Requirements for the Degrees of

Master of Science in Management
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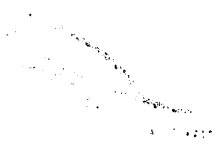

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Abstract

Product Proliferation has been identified as a problem for many companies with multiple product offerings. Rapidly changing market forces and technology shorten product lifecycles and require aggressive new product development activity. Meanwhile, lack of accurate product profitability information and a formal product end of life process have resulted in a failure to identify and aggressively retire products that no longer serve the strategic direction of the firm. The result is a net growth of the product portfolio. Over time, the increasing complexity of managing such a portfolio increases cost, dilutes the effectiveness of limited resources and weakens the competitive position of the firm.

This thesis describes a product end of life process that has been developed and implemented at Bay Networks to decrease product proliferation. A simple activity based cost (ABC) model is also described which is used to identify potential end of life candidates. Using these tools together can help a firm maintain a lean product portfolio that adapts to a changing strategic environment.

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Nomenclature

ABC	Activity Based Cost
ABM	Activity Based Management
ECO	Engineering Change Order
EOL	End of Life
ERP	Enterprise Resource Planning
FTE	Full Time Equivalent people
LAN	Local Area Network
MRP	Material Requirement Planning
NPI	New Product Introduction
OH	Overhead Cost
SKU	Stock Keeping Unit
WAN	Wide Area Network
WAPE	Weighted Average Percent Error
WWSOP	World Wide Sales and Ops Planning

Q	Quality Management Activity Overhead Cost
T	Total Production Overhead Cost
q	Percent FTE units dedicated to quality activities
X_Q	Product X Quality Activity Cost
X_{DL}	Product X Direct Labor Activity Cost
X_{NPI}	Product X New Product Introduction Activity Cost
X_{INV}	Product X Inventory Management Activity Cost
X_S	Product X Supplier Management Activity Cost
X_{OF}	Product X Order Fulfillment Activity Cost
X_{OP}	Product X Operations Management Activity Cost
X_{PL}	Product X Production Planning Activity Cost
X_A	Product X Administration Activity Cost

1-INTRODUCTION

1.0 Overview

In today's competitive market environment, "most companies competing in every segment...are pursuing aggressive product expansion strategies (Quelch and Kenny, 1994). As technology changes or consumer preferences change, companies must continually adapt and offer customers the latest, most advanced, highest quality or lowest cost products (McGrath, 1995). To this end, many companies have stepped up their new product introduction efforts. This thesis proposes that as market dynamics change and products are added to the product portfolio, companies should also be systematically eliminating products that no longer support the strategic direction of the firm. Retiring non-core products reduces cost and focuses company resources on those products that are most important to the firm's success. The author observes that most companies, however, do not have formal processes for retiring products. They also do not have accounting systems that accurately identify products that are not profitable. As a result, many companies do not proactively retire products and product portfolios become inefficient.

This thesis summarizes 7 months of work by the author to develop and implement a product end of life process and an activity based product cost system at Bay Networks. These tools have been successfully implemented to retire over 100 products and are being used at Bay Networks to continuously evaluate the product portfolio and retire products that do not support the strategic direction of the firm.

1.1 Problem Statement

Bay Networks history of rapid growth, combined with rapid technological change has resulted in an over-proliferated product portfolio. Over 80 percent of the company's revenues are generated by less than 20 percent of the company's over 4000 products. Meanwhile, the remaining 80 percent of the company's products continue to use valuable resources and distract management focus. The existing accounting system fails to quantify and allocate the perceived cost associated with carrying the large number of low volume products. Therefore, even though there is a general acknowledgement across the company that some products need to be retired, deciding which products to end of life has been difficult and slow. Recent efforts to retire products have been met with resistance and lacking a formal process, there have been problems in execution. To address

this problem, management has realized the need for a formal product end of life process integral to the total product lifecycle management process.

Discussions with managers at Polaroid Corporation, Compaq, The Stanley Works, and Boeing have indicated that many companies in a variety of industries have inefficient product portfolios. They have too many products that are minimally differentiated and many of which sell in low volumes. Offering such a large variety of products "reduces economies of scale in production; increases the complexity of production scheduling, inventory management, and logistics; and can reduce the effectiveness of the marketing and distribution strategy" (Wind, 1982).

Companies need to implement new accounting systems, product design practices and product lifecycle management processes to create and maintain a lean product portfolio that is flexible and adaptable to a changing strategic landscape.

1.2 Related Research

The cost and benefit of offering wide product variety has gained much research attention (Kekre and Srinivasan, 1990, MacDuffie et al, 1996). Shorter product life cycles brought on by rapid technological and market changes have increased the rate at which products are added to product portfolios (Fine, 1998). Yet for many companies product line complexity has been recognized as a problem (Porter, 1998, Shank and Govindarajan, 1993, Fonte, 1994, Ishii and Martin, 1996, Wind, 1982, Gould, 1979). While much has been written on how to improve New Product Development Processes (McGrath, 1996, Smith and Reinertsen 1995), much less attention has been paid to how to eliminate products (Wind, 1982). While Henderson (1979) recognized that some products in a portfolio are "dogs", very few companies have instituted formal processes for eliminating products (Greenley and Bayus, 1994). One explanation for this is that companies do not have tools to highlight products that are unprofitable (Kaplan, 1984).

1.3 Motivation and Overview

The need expressed by Bay Networks and other companies along with gaps in the literature provided motivation to develop a process for identifying and eliminating non-value added products from the product portfolio. Chapter 2 discusses the cause and effect of product proliferation at Bay Networks and at other companies. Chapter 3 proposes a product end of life process. This process includes a team structure, a decision making framework, and a step by step process for systematically eliminating products that are not key to the company's future. Chapter 4 presents an

Activity Based Cost system to more accurately measure product profitability than traditional accounting systems. Product profitability information is shown to be an important consideration when making product end of life decisions. Chapter 5 presents the conclusions drawn from this research project and summarizes the recommendations for Bay Networks. Some areas for further study are discussed.

2-PRODUCT PROLIFERATION

Strategy is making tradeoffs in competing, and choosing what not to do. (Porter, 1998)

2.0 Overview

This chapter establishes that product proliferation is an issue faced by a number of companies across a number of industries. This observation is based on interviews with managers at Bay Networks and at a number of other companies as well as documented cases in the literature. This chapter also illustrates at a high level how the product end of life process and activity based cost system are used to prevent product proliferation and maintain alignment between a firm's product portfolio and its business strategy.

2.1 Business Strategy and the Product Portfolio

In the dynamic business environment, successful companies reevaluate and adjust their business strategy as required to sustain competitive advantage. As shown in Figure 2.1, a company's product portfolio should not only support the current strategy but also must be flexible to meet the changing demands of the business environment.

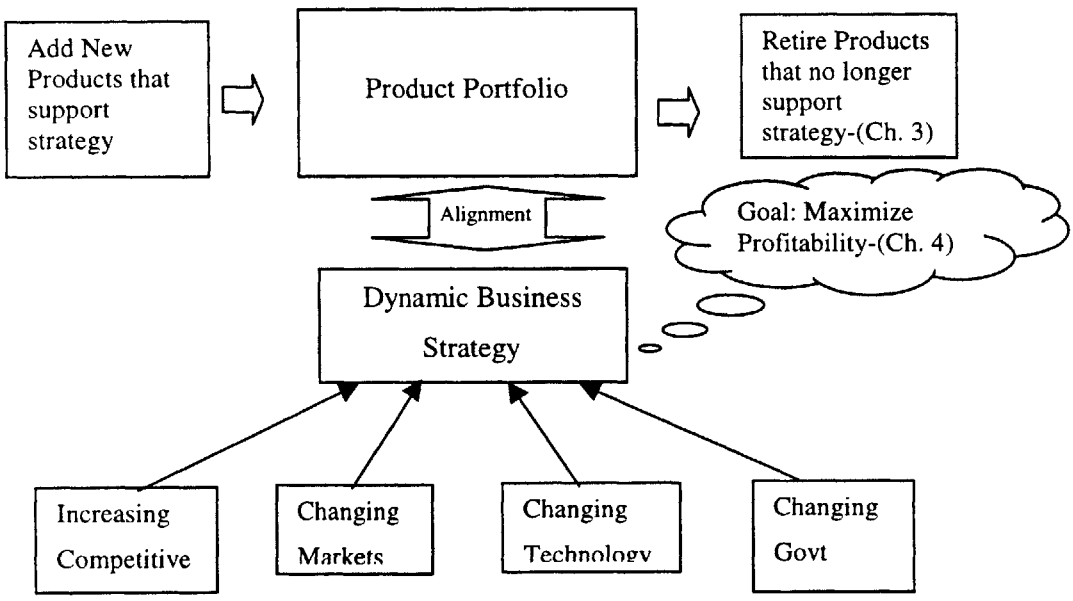


Figure 2.1 Maintaining Alignment between Business Strategy and the Product Portfolio

Unfortunately, many companies have been unable to maintain alignment between their product portfolio and their business strategy. Failure to retire non-value added products combined with aggressive new product introduction and a desire to offer a wide product variety commonly results in bloated product portfolios.

In a recent presentation entitled "From Operations Effectiveness to Strategy" Porter (1998) points out that growth pressures often lead managers to broaden the company's strategic position through product line extensions, new product features, imitating competitors popular services, etc. "Such broadening runs the risk of undermining strategy by blurring uniqueness, creating compromises, and reducing fit" (Porter, 1998).

Product proliferation also increases business complexity and cost, reduces organizational focus, and stresses limited resources. Over the long run, this leads to lower product quality, longer lead times and lower levels of customer service than can be achieved by a more focused competitor.

Recently, a number of senior managers at Bay Networks have come to believe that product proliferation is reducing their company's competitiveness.

2.2 Product Proliferation at Bay Networks

Bay Networks is a manufacturer of data networking hardware and software. They make the hubs, routers, switches and remote access devices that are the building blocks of local area networks (LAN) and wide area networks (WAN). Bay strives to provide end to end networking solutions for its customers and competes with Cisco Systems, Lucent Technologies, 3 Com and a host of other companies ranging from the large telecom giants to small datacom startups. Bay Networks has a product portfolio consisting of over 4000 stock keeping units (SKU's). Many of these SKU's represent similar products with various different combinations of memory configurations, power supply types (for use in various countries), media types (Ethernet, Token Ring, etc) and port configurations (12 ports, 24 ports, etc). While some of these SKU's are very popular, the majority sell in low volumes. In one of its low-end router product lines, 80 percent of the revenues are generated by 14% of the products. Because product proliferation is common across a number of companies and a number of industries, it is useful to understand how Bay Networks came into their present situation.

2.3 Causes of Product Proliferation at Bay Networks

There are three main causes of product proliferation at Bay Networks.

1. **Rapid Growth through acquisition.** Bay Networks was formed in 1994 from the merger of Synoptics and Wellfleet Communications. Like other companies in the industry, Bay has grown rapidly, largely through acquisition of smaller data networking companies like Xylogics, Centillion, LAN City, Penril and New Oak Communications. Bay's strategy was to acquire companies with key products or technologies so that they could quickly round out their product offering and attain the goal of being an end to end supplier of network solutions. In addition to gaining the target products, however, a number of acquisitions came with products that did not necessarily fit with Bay's strategy. However, Bay has continued to manufacture and support some of these products. More importantly, with each new acquisition, Bay acquired new product platforms. Since getting products to market quickly was the priority, Bay opted to maintain many of these platforms rather than consolidate the underlying technology into a few common platforms. Finally, Bay's recent merger with Northern Telecom promises to nearly double the number of products managed by the new Bay Networks division of Nortel Networks. The company anticipates a number of these Nortel products will overlap some of Bay's products in terms of functionality and performance.

2. **Organizational structure and culture.** Bay is divided into 4 product divisions, each with its own engineering, product management, and finance groups. These product divisions are further separated into smaller product line groups made up of teams of product managers and engineers often kept intact from the acquired company. There is little incentive for these product divisions to work together to standardize design around a common platform or use common parts across products. Most product groups work independently trying to optimize the price/performance of their particular products without much regard for optimizing the overall product portfolio.

3. **Rapid technological change.** The exploding popularity of distributed computing and the internet along with convergence between the data networking industry and the telecommunications industry has put a tremendous pressure on Bay Networks to continue to develop and market the latest, fastest and most advanced products. Bay must bring superior products to market faster and at lower cost than their very formidable competition. As a result, Bay is constantly adding products to their portfolio.

2.4 Product Proliferation in Other Industries.

The problem of product proliferation is not limited to Bay Networks or the data communications industry. There are numerous case studies in the literature, which show that too many products can hurt company performance. The American automobile industry in the 1980's for example was notorious for product proliferation. In 1986, GM's product line consisted of over $2x10^{17}$ different orderable combinations. By comparison, Honda offered 45 end unit combinations and Toyota offered 960 end unit combinations. Shank and Govindarajan (1993) pointed out that "The impact of this extreme degree of complexity in product choice on manufacturing cost is dramatic. Whatever value GM derived in the marketplace from this dizzying variety available (in theory) to its customers, it paid a tremendous price in the cost of the resulting manufacturing complexity." During the 1980's, Ford was the distant number two auto-maker and lagged behind GM in terms of cumulative experience, economies of scale, vertical scope and investment in new manufacturing technologies. Ford came to realize, however, that there were significant diseconomies of product line complexity. Over the next few years Ford significantly reduced the number of models it offered and decreased the number of options customers could select, and thereby gained significant cost advantage over GM. This effort contributed significantly to Fords gain on GM in unit cost and market acceptance between 1982 and today. (Shank and Govindarajan,1993)

In an example from another industry, John Trani, the CEO of the Stanley Works, blames product proliferation for recent poor company performance. A recent company press release states that "unnecessary depth of [Stanley's] product offerings preclude performance at levels expected by customers and inhibit efficient growth" (Stanley News Release, 1998). According to Mr Trani, the company has over 140,000 different SKU's that fill a product catalog of over 1200 pages of computer printout. Almost two thirds of these SKU's represent less than two percent of the revenues. Due to the huge amount of complexity associated with managing such an extensive product line, an equally huge amount of organizational effort and cost is required to manage the supply and demand for each of those 140,000 products. Currently "management is pursuing a dramatic product pruning program to remove low-selling items while focusing production on high volume offerings." (Stanley News Release, 1998)

There are many other examples where product proliferation has become a competitive issue. Managers at Boeing Corporation's Interiors Resource Center (IRC) have realized that customizing interiors for all of its customers is adding unaccounted for cost and complexity to their operation without adding a tremendous amount of value for their customers. They are currently looking for

ways to reduce the number of options available and focusing on features that add the most value for their customers (Boeing Interview). Executives at Polaroid Corporation have realized that some of its product lines have redundant variety that customers do not value. They too are investigating ways to reduce this problem (Polaroid Interview). Dell Computer has been very successful recently in part due to its modular product design which allows them to offer a moderate range of products without adding unnecessary complexity and cost to their operation. (Porter, 1998)

2.5 Reducing Product Proliferation at Bay Networks and elsewhere

Three actions are recommended to companies that are trying to reduce product proliferation and maintain alignment between the product portfolio and the business strategy:

1. **Implement a formal product end of life process.** Chapter 3 introduces a Product end of life process that was developed by the author and a cross-functional team of over 20 key people at Bay Networks to facilitate the retirement of poor performing products. To date this process has been implemented to retire over 100 products at Bay Networks. Because the EOL process uses the same cross-functional team structure used to launch new products, it dovetails with the company's NPI process to provide continuity over a product's entire life span.

2. **Institute a more accurate product cost model.** Traditional cost models distort product cost and prevent management from making sound product strategy decisions. Chapter 4 introduces an activity based cost model that was developed by the author for use at Bay Networks to help make product lifecycle decisions.

3. **Leverage a few product platforms across multiple product lines and design for variety techniques.** By standardizing product designs around a few standard product platforms, utilizing more modular architecture and maximizing the use of common parts across similar products, the company can simplify management of the supply chain, speed up product development cycle times and facilitate product retirement. Appendix 3 presents a summary of work by Meyer and Lehnerd as a starting point for possible follow on work.

3-A PRODUCT END OF LIFE PROCESS

In order to help Bay Networks streamline their product portfolio, the author led a group of over 20 key managers to develop an end of life process. The author then led two tactical end of life teams in the use of this process to retire over 100 stock keeping units. This chapter details the key elements of this process. Section 3.0 provides an overview of the process and subsequent sections describe the key elements of the process. Appendix 1 contains a detailed end of life checklist. Except where noted, all elements of this process have been officially approved and implemented and continue to be used on subsequent EOL projects.

3.0 EOL Process Overview

The product end of life process proposed by this study consists of nine elements as depicted in Figure 3.1.

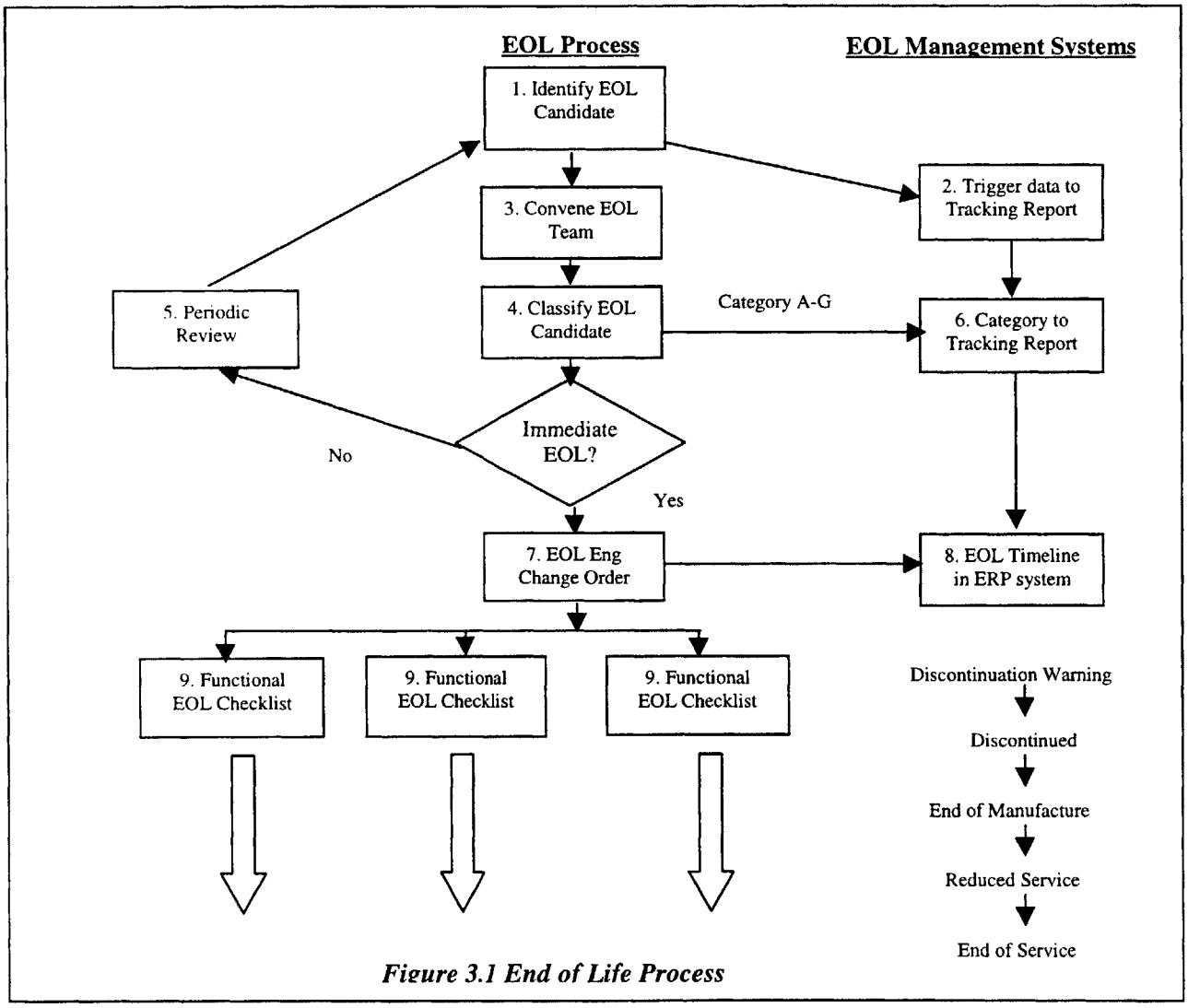


Figure 3.1 End of Life Process

This process identifies low performing end of life (EOL) candidates and defines an organizational structure for assembling the necessary information and making an end of life decision. It also provides a step by step guide for functional groups and suggests key management systems for executing and tracking EOL projects. While this process can be used in a one time, stand-alone effort to streamline the product portfolio, it should be implemented continuously. By integrating this EOL process with the new product introduction (NPI) process the company can maintain a lean product portfolio that adapts over time with changing technology and market demands.

3.0.1 The Importance of Product End of Life

Product end of life is not a trivial matter. Wind, (1982) states that "Explicit attention should be given to the product change/deletion decision since the potential profit contributions of such decisions are in many cases significantly larger (especially in the short run) than the profit contribution of the new product activities of the firm." Deciding what products to retire and when is a major challenge, however. Since product lifecycle decisions often require input from different functional groups within the company, lack of a formal EOL process can slow down decision making. At Bay Networks, for example, disagreement between manufacturing, product management and sales led to a 6 month delay in retiring over 150 stock keeping units (SKU's). Meanwhile, the company had to carry inventory both internally and at suppliers, and with every passing day lost the opportunity to transition customers to alternate products with similar or improved functionality.

Furthermore, once the decision is made to retire a product, there are numerous financial and strategic risks that can be mitigated by the EOL process. These include the risk of damaging customer relationships, eliminating strategically important products, and being left with a large excess of inventory. At Bay Networks, for example, lack of a formal end of life process had resulted in several reported problems. In one case, retiring a product late resulted in nearly $2 million in excess inventory that had to be written off.

3.0.2 End of Life Goals

Given the importance of Product End of Life, the goals of the EOL process are:

- To identify non-performing product order numbers (SKU's).
- To eliminate those non-performing products that have minimal strategic relevance for the company.

- To focus limited resources on the largest value-added products.
- To minimize the financial exposure/risk of being left with excess inventory or continuing to offer unprofitable products.
- To maintain the highest possible level of customer satisfaction.
- The EOL process should be systematic and efficient so that EOL projects do not drag out and draw excessive resources away from other activities.

3.1 Identifying End of Life Candidates

The first step in the EOL Process is to identify products that are at or nearing the end of their lifecycle. A set of rules must be established that can be agreed on by all functional groups in the organization and can be used to facilitate the decision making process. This is accomplished by setting trigger points or performance thresholds at which point a product should enter the EOL process. At Bay Networks, three triggers were identified as represented by Figure 3.2.

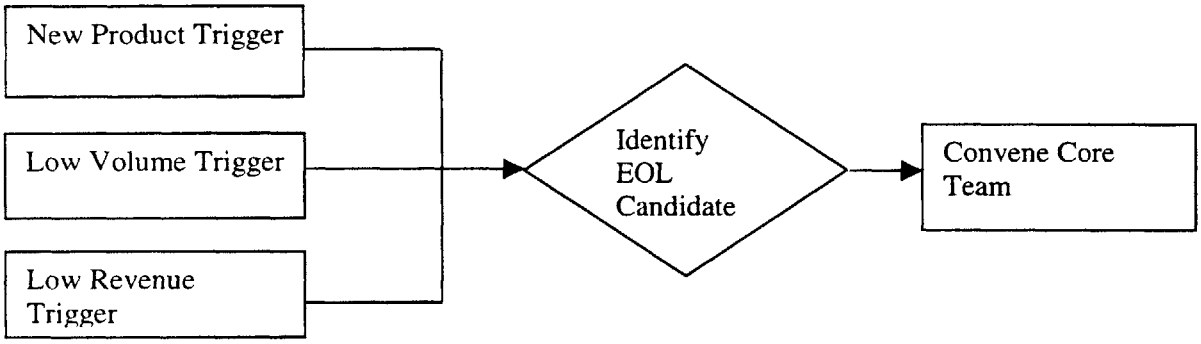


Figure 3.2 EOL Triggering Process

3.1.1 New Product Trigger

When a new product replaces an older product, the old product needs to be inserted into the EOL process. Since the execution and timing of rolling over one product to another is critical and often difficult, (Billington, et. al. 1998) the old product should enter the EOL process when the new product enters phase one of the NPI process as shown in Figure 3.3. This provides enough time for product management teams to assess market and technology risks, coordinate customer transitions, and manage inventories and manufacturing capacity appropriately.

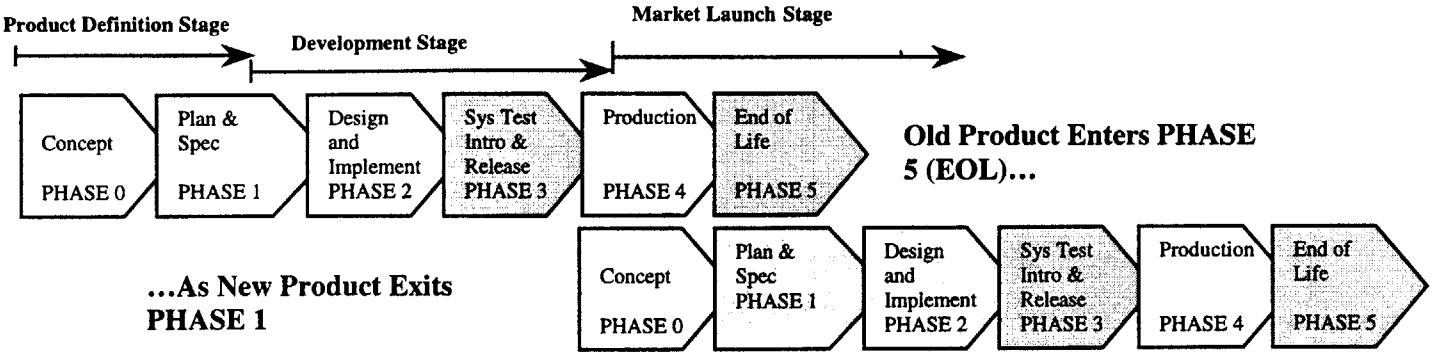


Figure 3.3 New Product Trigger Timing

3.1.2 Low Revenue Trigger

When a product's quarterly revenues drop below a certain, predetermined threshold point the product is inserted into the EOL process. Below the threshold level, the gross margins for the product do not justify the cost of maintaining the capability to manufacture, market and support the product. In the data networking industry, for example, there are numerous product niches which are simply too small. Too many low revenue products in aggregate draw substantial company resources and management attention away from core products that have much greater revenue potential.

3.1.3 Low Volume Trigger

The low volume trigger (Figure 3.4) is used to identify products that are on the downward trending side of their lifecycle. During a product lifecycle, unit volume will ramp up, plateau and then drop off. Therefore, when unit volume drops below a predetermined percent of the high quarterly volume point, the product is inserted into the EOL process.

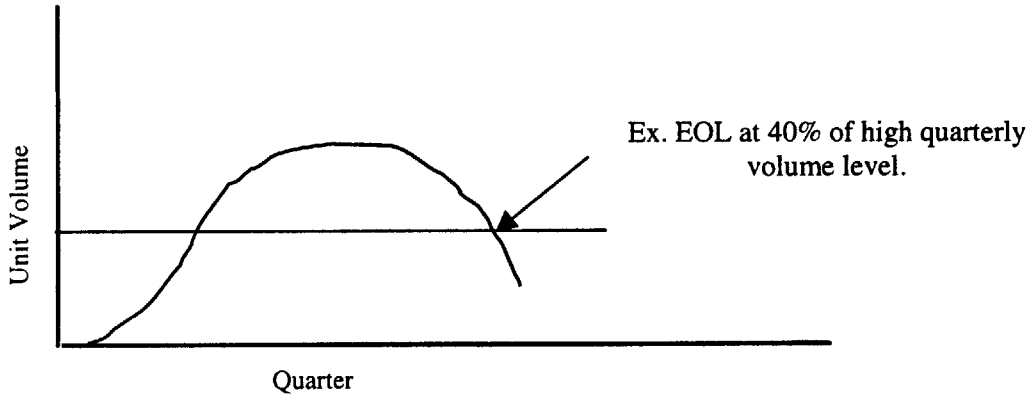


Figure 3.4 Low Volume Trigger Point

3.2 Triggered Products Added to Tracking Report

Trigger threshold levels are programmed into the company's ERP system. A tracking report (generated by the ERP system) that identifies all products satisfying any of the trigger criteria is used by management to assess the amount of EOL work required and assign resources. An automated trigger system will ensure that all products are screened and enforce discipline on the EOL process. Figure 3.5 shows an example of a tracking report. At Bay Networks, the automated trigger system and tracking report mentioned here and in section 3.6 are in the final stages of programming and debug. In the meantime, a number of products have been manually identified using the trigger criteria and EOL teams have been formed to systematically retire the products.

Product	Trigger	Trigger Date	Last Qtr Rev	Last Qtr Vol	Replacement Product
AD1001	Revenue	1/5/99	10000	10	
CX3009	Volume	1/14/99	300000	35	
DM2987	NPI	3/1/99	900000	500	DM3000

Figure 3.5 Sample Tracking Report

3.3 Convene the EOL Team

As is the case with product development processes, the most important element of the EOL process is the cross-functional team that works together to make and execute decisions. While many companies have established New Product Introduction teams, very few companies have a structured organization responsible for the managing the EOL process. After a new product is launched and ramped up through production, it is not unusual for the product development team to be disbanded and assigned to new products in the pipeline. Very little management attention is paid to the rest of a product's lifecycle (Meyer and Lehnerd, 1997).

As Katzenbach and Smith (1993) observed, "teams are the primary unit of performance in an increasing number of organizations [and] teams naturally integrate performance and learning." While the rest of the EOL process is a useful guideline for the EOL team and should facilitate EOL projects, it is the team organization that will determine the success of the process. The complexity and uniqueness of each product lifecycle decision prevents a cookbook solution for the product end of life process. Bringing the right group of people together and assigning them ownership of the process significantly improves the odds that products will be effectively retired.

As shown in Figure 3.6 a, the EOL team implemented at Bay Networks includes key people representing each of the major functional areas affecting or influencing product end of life: Product Management, Operations, Customer Service, Sales, Marketing, Finance, and Engineering. Other functional groups are asked to join specific team meetings when their area of responsibility is discussed. While the product manager has the ultimate authority for decisions affecting product lifecycle management, she carefully considers input from all team members. To help resolve conflict among team members and facilitate the process, a program manager is assigned to the group from a central corporate group. Core team members from each function act as the liaison between the Core team and their functional organization. The Core team members typically lead sub teams as shown in Figure 3.6 b within their respective organizations to deal with the detail level of EOL management.

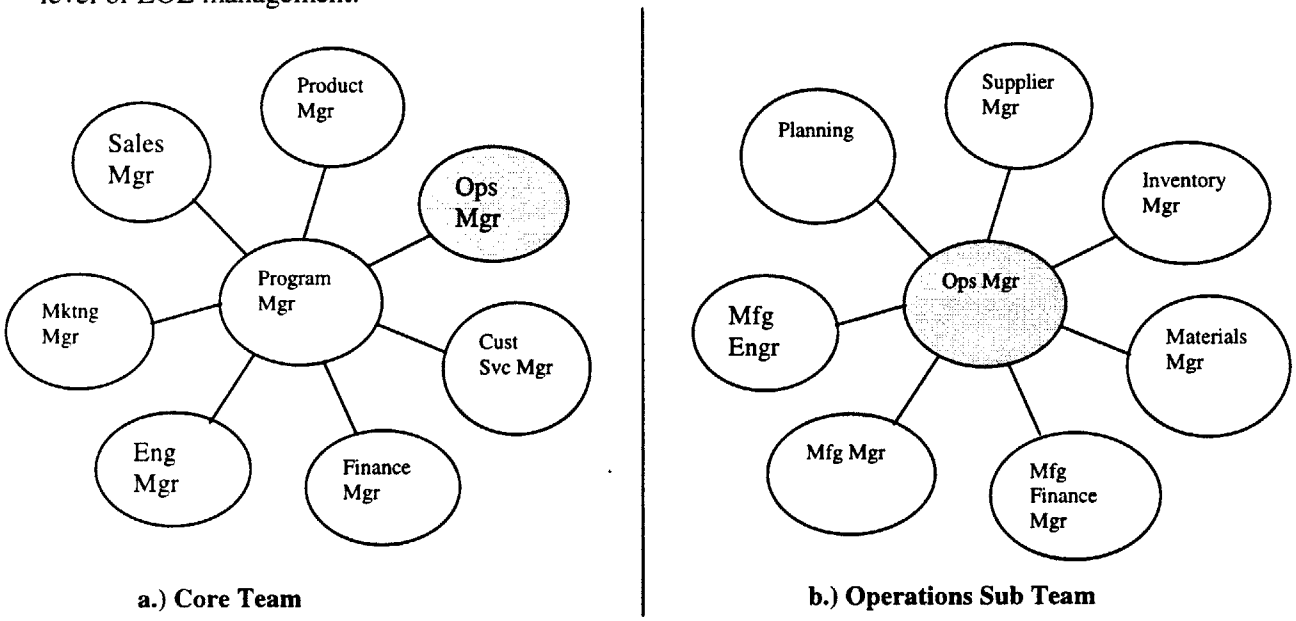


Figure 3.6 a and b: EOL Cross Functional Core Team and Sub Team Structure

3.4 Classify EOL Candidate

The first tasks facing the EOL team are: 1.) to bring together more detailed information regarding the supply and demand for the product and 2.) assess any product or market risk associated with retiring the product. This information is used to classify the EOL Candidate into one of seven categories (A-G). The amount of time the product has left before it is actually retired, depends on the specific situation for that product. Where the EOL triggering mechanism forces discipline on the EOL process, the EOL classification of a product adds some flexibility to allow strategic or other environmental considerations to affect how a product is handled.

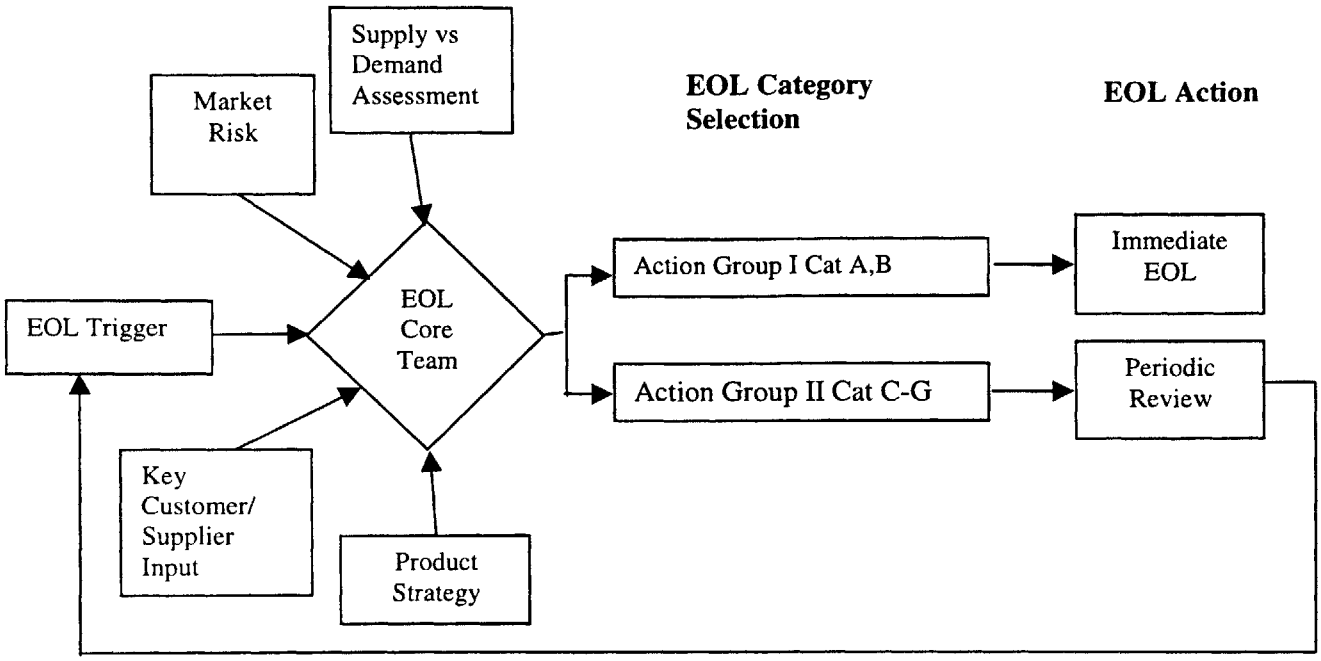


Figure 3.7 EOL Classification

The seven different classifications (A-G) are separated into two action groups (I and II). The action groups and EOL categories that a product can be placed in are summarized in Table 3.1.

Action Group I: Product Ready for Immediate EOL		
Category	**Explanation**	**Action**
Category A	Low Revenues or Volumes	Immediate EOL
Category B	Replaced by New Product	Immediate EOL

Action Group II: Product not Ready for Immediate EOL, Periodic Review required		
Category	**Explanation**	**Action (for periodic review)**
Category C	Strategically Important Product	Periodically review strategic situation.
Category D	Large Inventory Exposure	Implement inventory reduction actions-pricing changes, firesale, other incentives.
Category E	High Expected Revenue	Work with sales force to realize sales potential.
Category F	No Replacement Product	Anything in development? Other product options externally or internally?
Category G	Early Warning	Communicate with new product development team to coordinate product rollover.

Table 3.1 EOL Categories

Action Group I products are those products for which immediate steps are taken to EOL the product. In other words, revenues and/or volumes have hit the trigger points and the EOL team sees no strategic or tactical reason for not retiring the product. Once this decision is made, the team agrees on a time line for retiring the product and each of the functional groups has specific tasks that they are responsible for carrying out. The team will meet periodically to ensure that issues are resolved and that EOL tasks are being completed according to the agreed to timeframe.

3.5 Periodic Review of Action Group II Products

Action Group II products are those products that have been triggered into the EOL process but are not ready for immediate EOL action. These products enter into a holding process with periodic review. Here effort should be made to move the product into Action Group I, but the product does advance further in the EOL process. For example, if the product is a strategically important product, because it is used in conjunction with other products, then the product is designated category C. If there appears to be a large inventory that needs additional time to be sold off, then the product would be given category D. Meanwhile, steps should be taken to reduce inventory so that the product can be moved into Action Group I. Category E is assigned if the Product Manager or Sales force can provide evidence that revenues are increasing enough to merit waiting to retire the product. Category F is assigned if the team determines that the product should not be retired unless there is a replacement product. Category G is assigned if there is a replacement product which is currently in development but the timing of the new product is still too uncertain to actively take steps to EOL the current product.

3.6 EOL Category Information Added to Tracking Report

As a product advances through the EOL process, additional information is added to the EOL tracking report. For example, the EOL category that has been assigned to each EOL candidate is added to the report. This helps management ensure that EOL candidates are moving smoothly through the process (See Figure 3.8). As mentioned in section 3.2, the tracking report is in the final stages of debug and will be fully implemented at Bay Networks in the near future.

Product	Trigger	Trigger Date	Last Qtr Rev	Last Qtr Vol	Replacement Product	EOL Category	Category Date	EOL Step
AD1001	Revenue	1/5/99	10000	10		A	1/15/99	DW
CX3009	Volume	1/14/99	300000	35		C	1/25/99	N/A
DM2987	NPI	3/1/99	900000	500	DM3000	B	3/15/99	DW

Figure 3.8 Tracking Report with Category and EOL Step Information

3.7 EOL Engineering Change Order

Once a product is designated as an Action Group I product, it is actively and aggressively retired. The EOL Core team agrees on the timing of specific EOL milestones that are appropriate to the particular product being retired (a general guideline is provided in Section 3.8). An Engineering Change Order (ECO) is then written specifying which products are being retired and the EOL timeline. This ECO is signed by all team members and is sent to an ERP management group who programs the ERP system to automatically step the product through the EOL timeline. Changes to this timeline require another ECO. This formal system is meant to provide discipline to the process and is intended to reduce the amount of management attention required to keep the EOL process moving forward.

3.8 EOL Timeline

The End of Life timeline is broken down into four phases shown below in Figure 3.9.

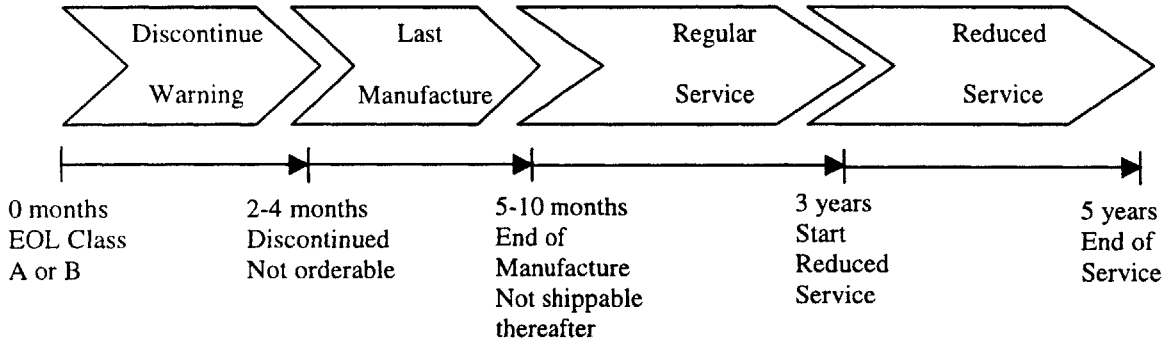


Figure 3.9 End of Life Timeline

3.8.1 Product Discontinuation Warning

Product Discontinuation Warning is a period of time during which the product catalog is annotated to inform customers that the product is going to be discontinued soon and which products, if any, are suitable replacements. This provides customers adequate warning so that they can choose to make a last time purchase if the suggested alternative products do not completely serve their needs. Prior to placing a product in to Discontinuation Warning status, a number of things need to be done. Contracts need to be reviewed to determine if any special circumstances exist that might require a longer than normal warning period. Suppliers and distributors need to be communicated and worked with to reduce inventory and to ensure that each party's interests are being considered. Often suppliers and distributors will have input into the decision making process and the EOL timeline.

3.8.2 Product Discontinuation

Approximately 2-4 months after the discontinuation warning has been issued, the company then removes the product from the product catalog, and the ERP system would be programmed to no longer accept new orders. Two to four months corresponds to the typical warning time negotiated into most contracts and provides additional time to reduce inventory, and ensure that suppliers and distributors are doing the same. This also provides time to familiarize the sales force with recommended replacement products and for the EOL core team to deal with any last minute problems.

3.8.3 Product End of Manufacture

The EOL process then allows approximately 3-6 months to conduct a final assessment of supply versus demand and to schedule/complete all manufacturing. During this period, customer service determines the final installed base of product in the field and uses historical failure rates to forecast repair parts demand through end of service. Customer service then makes a last time purchase to ensure an adequate store of spare parts. After End of Manufacturing, product, process and test documents are archived, manufacturing capacity is removed or redeployed and excess inventory and capital equipment is written off.

3.8.4 Reduced and End of Service

It is Bay Network's policy to offer customer service contracts and product warranty to customers purchasing new product. Therefore, at product EOL, the company must plan for and manage customer service for products made through the date of last manufacture. Bay typically offers two

service levels for new product: Next Day Advanced replacement is the highest level of service where Bay guarantees product replacement within 24 hours. A lower service level was also available where replacement product would normally arrive within a week. Since customer service contracts normally last one year, the company adopted an end of life policy to offer Next Day Advanced Replacement for two "renewal cycles" or approximately 3 years after end of manufacture. After 3 years, only the lower service level would be offered. Finally, after five years, customer service contracts are not be renewed.

3.9 Functional Group's EOL Responsibilities

Once the product has been given an EOL category (A-G) then the core team starts to take tactical steps to move the product through the EOL process. If the product has been placed in Action Group I (Category A or B) there is a well defined plan with specific deliverables for each functional area to EOL the product in a systematic and efficient manner. For Action Group I products, each functional group has a well defined procedure and checklist to ensure that nothing is missed and that the EOL project is carried out in a timely manner. (See Appendix 1 for an example of a functional area checklist.)

If the product has been placed in Action group II (categories C-G) there is not a well-defined plan of action because, each situation is unique. The underlying goal is for the EOL core team to assess the situation, develop a plan and move the product toward becoming an Action Group I product. Since all the necessary people to make good decisions are on the core team and since the automated trigger report allows management to track the progress of all EOL products, it is expected that all Action group II products will be well managed and the appropriate actions taken.

3.10 Summary

This end of life process was developed and implemented by the author with a team at Bay Networks to effectively retire two groups of products (representing over 100 SKU's) in less than 7 months. Learning from those initial two EOL projects was incorporated into the current process. The author has formally incorporated this process into the company's ISO 9000 system and has trained over 60 key people to use this process. Although the automated tracking systems mentioned in sections 3.2 and 3.6 are still being developed, a number of additional EOL candidates have been identified. EOL teams have been formed at Bay and at other Nortel Networks divisions to retire those products using this process.

As described in Chapter 2, the EOL process combines with the New Product Introduction (NPI) process to align the product portfolio with the strategy of the firm. Early results of this process implemented on the two product groups at Bay Networks indicate that it will achieve all of the seven goals of an EOL process described in the introduction of this chapter.

Of course, not every product or situation falls neatly into the triggering or classification mechanisms and certain exceptions will need to be made. The cross functional team structure described in Section 3.3 compensates for this since ownership for decision making has been placed with those best able to make informed choices. One critical but missing piece of information that the team needs to make effective decisions is product profitability. As shown in Figure 3.10, product profitability information should be used as both an EOL trigger and as a basis for assessing the strategic tradeoffs associated with retiring a product. Part of the reason product profitability is not part of the decision making process is that Bay Networks, like many companies, does not do a good job at tracking cost at the product level.

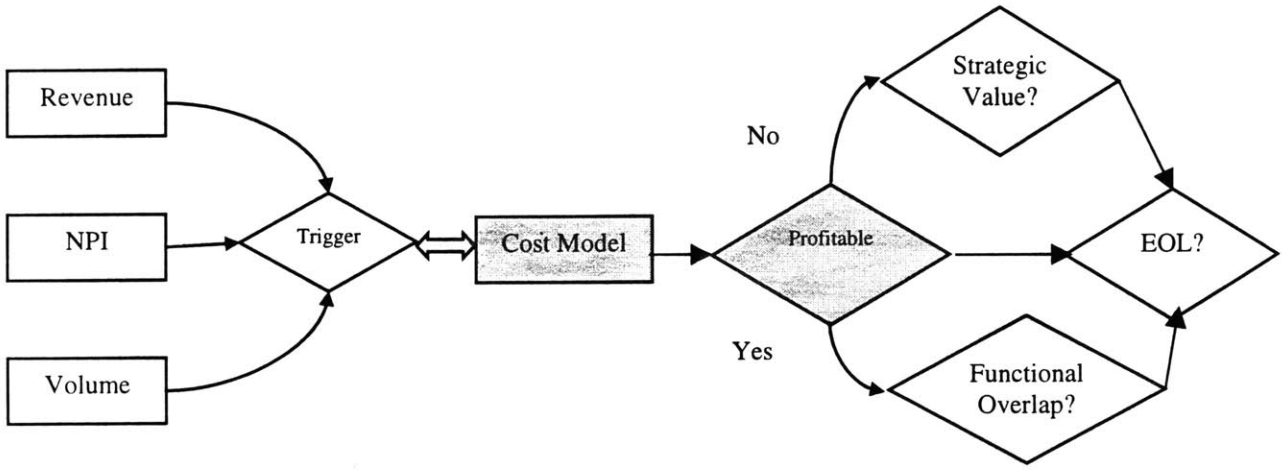


Figure 3.10 Importance of Product Cost in EOL Decision Making

Chapter Four discusses the current accounting system in more detail and proposes a simple Activity Based accounting system which can be used to provide more accurate product cost information and therefore improve the EOL decision making process.

4-USING ACTIVITY BASED COSTING TO GAIN A BETTER ESTIMATE OF PRODUCT PROFITABILITY

> *Most large companies seem to recognize that their cost systems are not responsive to today's competitive environment...the methods they use to allocate costs among their many products are hopelessly obsolete....Quite simply, accurate cost information can give a company competitive advantage. (Worthy, 1987)*

4.1 Introduction

It is critical to quantify product profitability when making product end of life decisions. While not the only decision-making criteria, product profitability enables a quantitative comparison of various strategic options. As Shank and Govindarajan (1993) point out, "Explicitly managing the tradeoff between the value of variety in the marketplace and the cost of complexity in the factory or the distribution channel requires an accurate assessment of product cost".

At Bay Networks, for example, lack of product profitability information made it difficult to gain consensus on which products to retire and when. Each functional group within the company tended to have different perspectives. Operations people tended to be very cost conscious and were therefore quite willing to retire non-performing products. Meanwhile sales and marketing people tended to want to keep all customers satisfied and were hesitant to eliminate any products. It was difficult for operations to make a compelling argument for retiring a product without accurate product profitability information.

Ironically, most companies do not have accurate estimates of product profitability. The problem is that while companies normally can keep track of revenues generated by individual products, it is far more difficult to track costs incurred by individual products. Companies with complex product lines typically have substantial indirect costs associated with planning and managing the supply chain, providing customer service and other selling, general or administration costs. These overhead costs often get allocated to product on the basis of direct labor content, volume, material content or some other arbitrary method.

Current management accounting literature has shown that such traditional cost accounting systems distort product cost (Shank, Govindarajan, 1993). "Cost distortions often occur when shared costs

are allocated to products in ways that do not reflect how these costs are incurred. Consequently, some products can be subsidizing others by being burdened with a disproportionate amount of cost" (Esqueda, 1998). Worse than providing no information, these traditional cost accounting systems actually provide mis-information that can cause companies to make wrong decisions.

Bay Networks uses a traditional style cost system that allocates cost on a percent of material basis. As a result, this cost system does not provide managers with a reliable estimate of product cost. This chapter illustrates the existing product cost system and points out some of its weaknesses. The author then introduces an alternative, activity based cost analysis which provides managers with more accurate product cost information which can be used in end of life and other business decision making.

4.2 Product Cost Components at Bay Networks

Product Cost at Bay Networks consists of material cost plus overhead cost. Material cost represents 60-70 percent of total product cost. Overhead cost can be further broken down into production overhead representing 20-30 percent of total cost and other overhead costs (warranty cost, royalty cost, plus other service, sales and administrative costs) that make up about 10 percent of total cost. (See Figure 4.1).

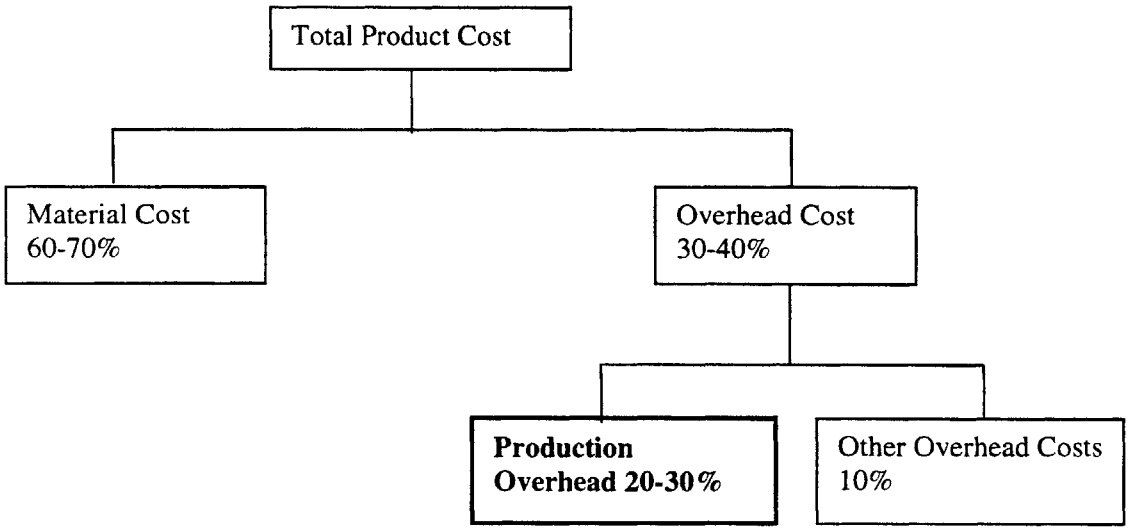


Figure 4.1 Basic Elements of Product Cost

Material cost is relatively well known since this is the cost charged to Bay Networks from suppliers of boards, boxes, power supplies, etc. and is kept track of by the company's ERP system. This

chapter proposes an activity based methodology for assigning production overhead costs to products. The distributed nature of data for other overhead costs made their inclusion beyond the scope of this thesis. The activity based methods described here, however, could be extended to those other elements of overhead cost.

4.3 A Note on the Significance of Production Overhead Costs

Although material costs make up the most significant portion of the product costs, there is ample reason to make sure that the production overhead is accurately assigned to products. First of all, production overhead representing 20-30 percent of costs translates into a very large dollar figure. At Bay Networks, overhead costs and non-allocated period costs were in excess of $50 million annually.

Secondly, Bay Networks, like many modern companies is increasingly becoming a more "leveraged" or "virtual" manufacturing company. This means that more and more of the manufacturing occurs at contract manufacturers. Contract manufacturers who originally just built printed circuit boards for Bay are increasingly asked to handle much of the final assembly, test, repair, inventory and distribution functions for Bay Networks product. Bay's role in the value chain is mainly focused on new product design and development, marketing, sales, service and coordinating all the other parts of the supply chain to deliver the best total solutions to customers faster, at lower cost and with higher levels of customer satisfaction. This means that from a cost perspective, most internal manufacturing labor is indirect labor and operationally, overhead is not only a growing element of cost, but it is the most controllable by Bay's operations managers. In order to improve Bay's internal operations, managers need to understand the internal drivers of cost.

Third, once Bay establishes a more accurate activity based cost system in house, they can then be in a better position to help their suppliers do the same. The same activity based methods proposed here can be applied to Bay's suppliers. There are reasons to suspect that material costs charged to Bay by suppliers could be inaccurate, especially for low volume products. One Bay Networks' supplier engineer spoke of a product that sold approximately 35 units per quarter. He spent many hours negotiating material cost with the supplier to keep material costs low enough so that Bay could achieve certain target margin numbers on the product. Not only did he spend a disproportionately large amount of time on a very low volume product, but the fact that he was

successful in negotiating a low price for the boards raises questions of what other products might be subsidizing the material cost of this product.

4.4 The Existing Production Overhead Allocation System at Bay Networks

Production overhead at Bay Networks consists of both direct and indirect expenses incurred within Manufacturing Operations, to support the production of both internally and externally built Bay Network products. Overhead is allocated to products on a percent of material basis. Every six months, departmental managers (about 60) allocate their forecasted overhead costs for the following six month period across approximately 24 different product pools. The product pools are predetermined by a cross-functional team which classify products by internal/external manufacturing processes, product complexity, etc. Once this is done the overhead costs for all departments are summed for each product pool. Meanwhile, the sales forecasting group forecasts the quantity of units which will be sold in the coming six months for each product group. The cost of materials for the forecasted sales is estimated using historical cost. The forecasted overhead cost for each product pool is then divided by the estimated material cost for the product to get a percent of material cost. As product is manufactured, materials are purchased and the percent of material overhead rate is added to the total cost. Table 4.1, below, shows a simplified example of how overhead rates are calculated using four product pools and 4 departments. This process is repeated every six months.

	Product Type A(high volume, few flavors, external mfg) Ex 350 T	Product Type B (low volume, many flavors, ext mfg) Ex IIG	Product Type C (high volume, few flavors, interal mfg Ex. Catapult	Product Type m (low volume, many flavors, internal mfg) Ex. Annex 3
Department 1	700	50	200	250
Department 2	300	150	180	100
Department 3	400	75	250	200
Department n	0	75	150	100
Total Product Overhead Cost	1,400	350	780	650
Total Forecasted Quantity of Product to be Sold	110	3.4	3.7	10.7
Total Forecasted Material Cost	60,000	1,875	22,500	5,575
Computed Overhead rate (as a percent of material)	1,400 / 60,000 = **2.3%**	350 / 1875 = **18.7%**	780 / 22,500 = **3.5%**	650 / 5575 = **11.7%**

Table 4.1 Overhead rate calculation in existing system

(numbers in thousands)

Although this system satisfies financial reporting requirements, it does not provide managers with an accurate estimate of product cost. There are two reasons to believe that this accounting information is inaccurate:

1.) This system is based on six month forecasts of demand, material costs and departmental costs. These forecasts determine the overhead allocation rate for each product. At the product level there is a tremendous amount of demand variation month to month for most of the products and as a result sales forecasts are not highly accurate. In fact, sales forecasts made six months out for individual product families have an average 60 percent error with some product forecasts having significantly more error. Furthermore, the allocation of department costs to product pools is not data driven but the summation of each managers best guess as to where resources are going to be spent. It is possible that managers are highly inaccurate in this process. For example, a manager might allocate cost to product pools based on memory of recent events and not on longer term trends. The dependence of this cost allocation scheme on such highly inaccurate forecasts raises significant questions about the validity of this system.

2.) This system erroneously assumes that production overhead cost varies in proportion to material cost. Cost drivers such as quality level, product line complexity, supply chain complexity, experience curve effects and technology are simply ignored. In the example where sales volume for a product turns out to be much lower than expected, it is not reasonable to think that overhead associated with that product should decrease proportionately as the existing system suggests. Overhead associated with a particular product would more likely **increase** proportionally with unexpected **increases or decreases** in demand. As demand changes unexpectedly, more organizational resources need to be applied to analyze the situation, adjust production schedules, negotiate with suppliers and customers and manage inventories. This problem is particularly significant for products that are selling at low volume and are End of Life candidates. Even though some of these low volume products have quality problems that require a lot of attention or high inventory that needs to be reduced (due to unplanned drop in demand for example), they are charged a disproportionately small amount of overhead because their material cost is low. Interviews with Operations managers revealed their frustration trying to convince product managers that actual cost to the company was higher than reported by the cost accounting system.

4.6 Using ABC Methodology to Allocate Overhead

Activity Based Cost (ABC) systems have been around since the mid 1980's and were developed to meet the need for more accurate information about the cost of resource demands by individual products, services, customers and channels (Kaplan and Cooper, 1998). ABC systems enable indirect and support expenses to be driven, first to activities and processes and then to products, services and customers. The systems give managers a clearer picture of the economics of their operations. ABC has led to Activity Based Management (ABM): the set of actions that can be taken, on a better-informed basis with activity based cost information. ABM can be broken down as shown in Figure 4.2 into two complementary applications: Operational ABM and Strategic ABM. (Kaplan and Cooper, 1998)

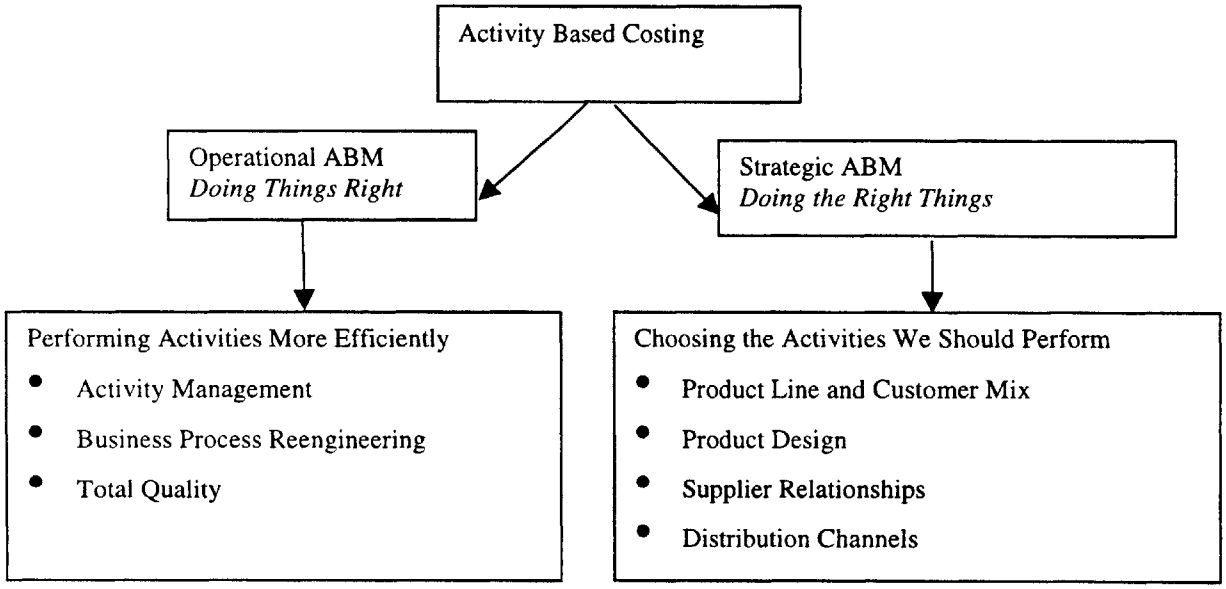


Figure 4.2 Using ABM for Operational Improvements and Strategic Decisions
(Adapted from Kaplan and Cooper, 1998)

Operational ABM can be thought of as "Doing things right" to improve business process efficiency. This can be done by eliminating non-value added activities, reducing machine downtime, simplifying approval processes, increasing asset utilization, etc.

Strategic ABM can be thought of as "Doing the right things." Here the focus is on which products or services are most profitable while avoiding or eliminating products or services which are

unprofitable. Strategic ABM assumes as a first approximation that activity efficiency remains constant. The idea here is to shift activities to the products or services that bring the company the most profit. While the Activity Based Cost information gathered at Bay Networks was used for both operational and strategic purposes, this thesis focuses on a strategic use: which products should the firm be focused on and which products should they consider retiring?

4.6.1 ABC Methodology Overview

Activity Based Costing assigns overhead cost to products in a four-step process as shown in Figure 4.3. This process is a modified and simplified version of the ABC methodology presented by Kaplan and Cooper (1998). In the first step, the basic activities or business processes that make up the business are identified. Examples of activities are supplier management, quality management, inventory management, etc. Next, interviews and surveys of employees across the organization are used to determine the breakdown of overhead cost to each of those activities.

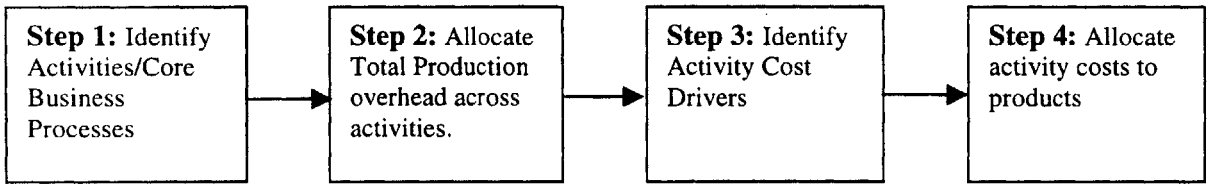


Figure 4.3 Four Step ABC Methodology

In the third step, activity cost drivers are identified for each activity where "an activity cost driver is a quantitative measure of the output of an activity" (Kaplan and Cooper, 1998). Finally, overhead can be allocated from each activity to products based on the proportion of activity cost driver dedicated to that product. Once these steps are complete, the activity costs associated with a particular product are summed to produce a total production overhead cost for the product. Figure 4.4 demonstrates the flow of overhead cost to products using the ABC methodology. The following sections describe in greater detail the mechanics of these four steps as applied to products at Bay Networks. While much of the actual cost data is omitted for company confidentiality reasons, a case study of a product (name disguised) being considered for end of life is used to illustrate the process.

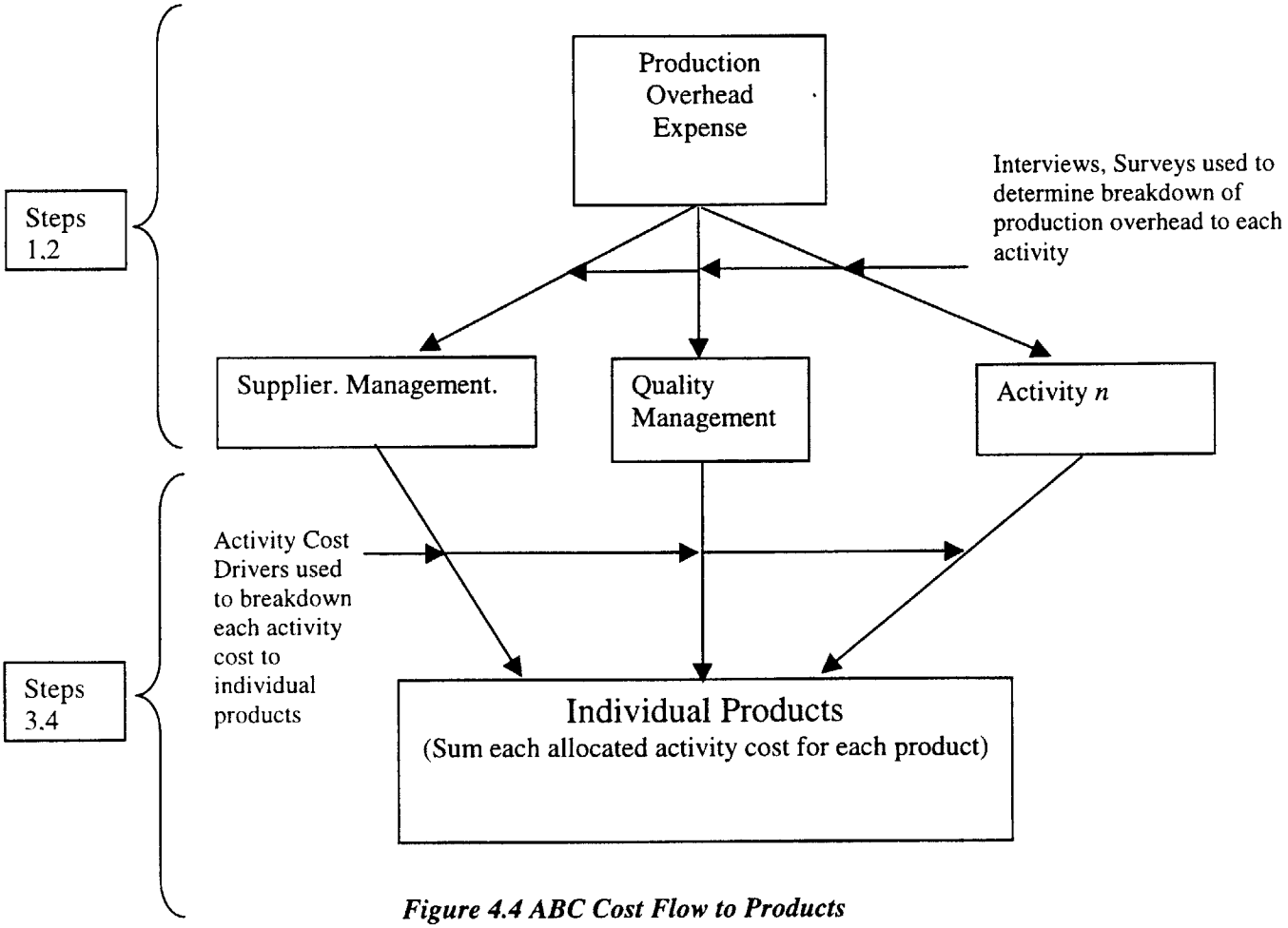


Figure 4.4 ABC Cost Flow to Products

4.6.2 Step One: Identify Activities

The first part of this step is to identify the key activities carried out by the organization. In this case, the key operations managers met and selected nine major activities described in Table 4.2. Although it would have been possible to define activities at a much more micro-level, there is a clear tradeoff between the accuracy of the system and the complexity and cost of it. "Activity dictionaries can be relatively brief, say 10-30 activities, especially where the prime focus of the ABC system is to estimate product and customer costs." (Kaplan and Cooper, 1998). Given the intent of this study the author determined that nine activities were adequate. If more accurate cost estimates become necessary, more detailed activities can be added.

Activity	General Description
Direct Labor	Direct Labor for final assemble and test in house
New Product Introduction	Prototyping, pilot production, engineering review, testing leading to production of new product
Supplier Management	Coordinating external manufacture of boards/boxes. Escalate Quality, inventory issues, manage EM performance
Order Fulfillment	Taking orders, entering them and follow up through fulfillment
Inventory/Material Management	Managing suppliers of raw materials, managing internal inventory
Operations	Management of production, capacity planning, ECO admin, pick lists, emergency response
Quality Management	Processing Defective returns, maintain quality database, root cause analysis and follow up
Demand Forecasting (World Wide Sales and Ops Planning)	Forecasting future demand for each product
Administration	Management Activities, Documentation, Emergency Response

Table 4.2 Bay Networks Business Processes

4.6.3 Step Two: Allocating Total Production Overhead to the basic business activities.

Next, every employee (about 900 people) in Bay Networks Operations in Santa Clara CA and Billerica MA plants were surveyed and asked to divide their time across the various activities. Employees were supplied with an activity dictionary with more detailed descriptions of each activity to help them determine which activities they participate in. A brief description of each activity is included in Appendix 2.

The data from the survey was compiled and for each business activity the total amount of time spent was summed to get a total quantity of Full Time Equivalent (FTE) units spent on each business process. The following equation demonstrates the calculation of Quality Management Activity Cost, Q.

$$Q = T*q \qquad \textit{(Eqn 4.1)}$$

Where T is the total production overhead in a given period and q = percentage of FTE dedicated to Quality Management Activities as measured by the ABM survey.

Similar relationships allocate total production overhead to each of the other eight business activities. The percentage breakdown of total overhead to each activity is represented in Figure 4.4.

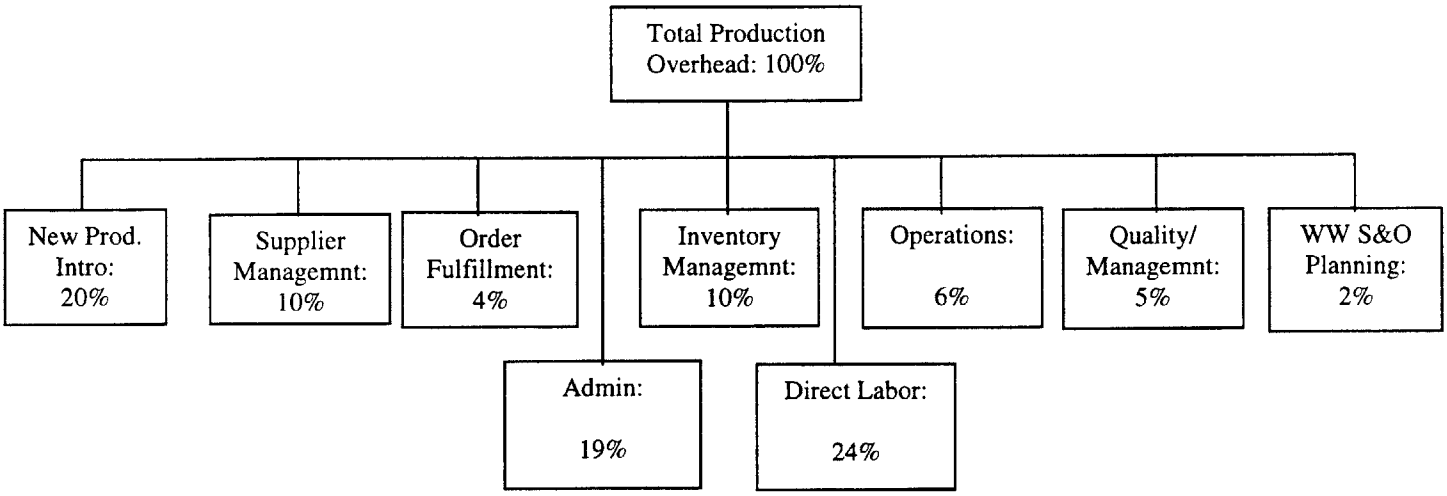


Figure 4.5 Breakdown of Overhead across Business Activities

For the purposes of this analysis we assume that for a reasonably short time frame (6-12 months) the distribution of overhead to these activities is fairly constant. Over this time frame each person's job description does not change dramatically and unless there is a corporate reorganization or reengineering effort going on, there should not be much short term change. For longer periods of time, or in the case where there is corporate reorganization, the ABM survey would need to be repeated.

4.6.4 Step Three: Identifying Activity Cost Drivers

Once the total production overhead is assigned to each of the nine main business activities, the next step is to identify logical cost drivers that can be used to allocate the business activity cost to specific products. Kaplan and Cooper (1998) state that "The selection of an activity cost driver reflects a subjective trade-off between accuracy and cost of measurement". Cost drivers were determined after interviewing managers and other key personnel in each of the functional departments that led the business process. Their input, along with the availability of cost driver data determined which cost drivers were used. Fortunately, Bay Networks maintained several electronic databases that provided the relevant cost driver information needed. With more time and a larger budget, other cost driver information could be gathered resulting in a more accurate estimate of product cost. Table 4.3 outlines the main cost drivers identified for each of the business processes. A brief explanation of why each cost driver was selected for each business process is supplied in Appendix 2.

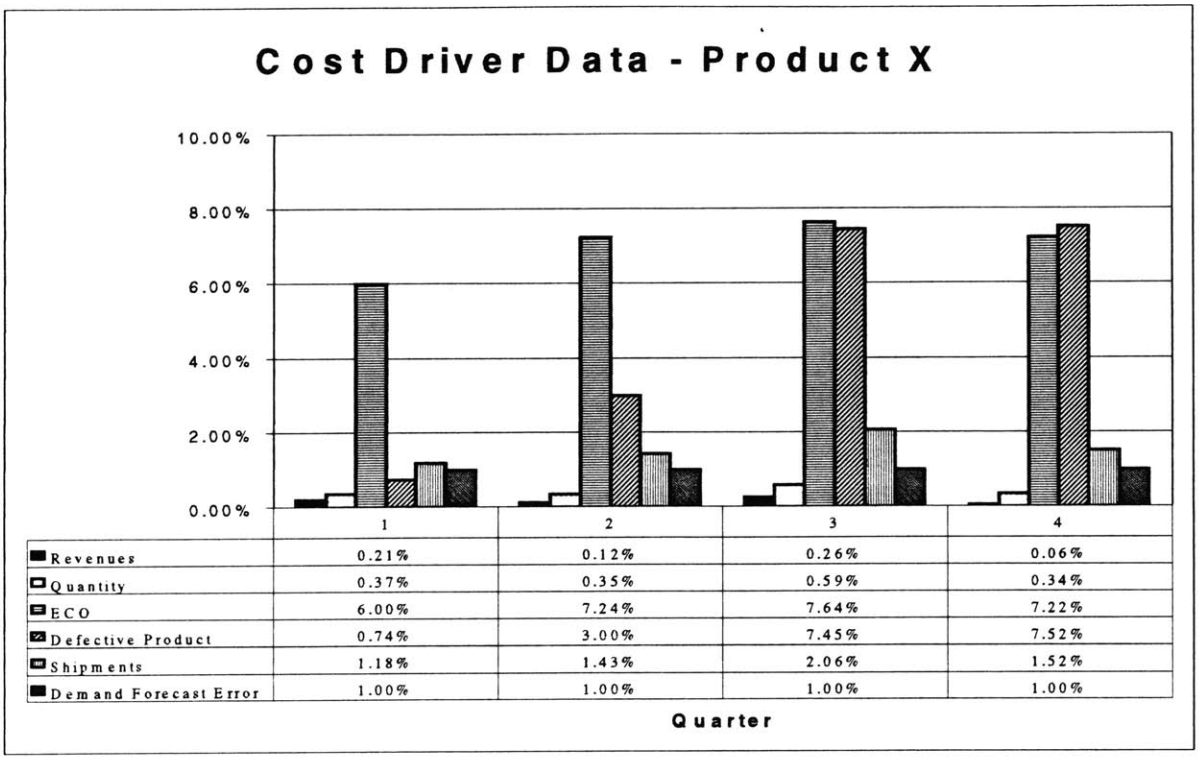
Business Activity	Cost Driver
Direct Labor	Labor Standards, Unit volume
New Product Introduction	Number of Engineering Change Orders (ECO's)
Supplier Management	Demand Variation, ECO's
Order Fulfillment	Number of Orders (Invoices)
Inventory/Material Management	Number of Shipments, Demand Variation
Operations	Unit Volume, Demand Variation
Quality Management	Number of Defective Returns
Demand Forecasting (World Wide Sales and Ops Planning)	Demand Variation, Line Items Planned
Administration	Aggregate distribution of the other 8 business processes

Table 4.3 Activity Cost Drivers for Each Business Process

4.6.5 Step Four: Using Cost Driver Data to Allocate Production Overhead from Business Activities to Specific Products

Collection and Use of Activity Cost Driver Data.

The next step was to collect the cost driver data. As mentioned, the data was available in various databases and could be extracted for the purposes of this analysis. One database stored the Engineering Change Order (ECO) information, another database kept track of the defective returns information and a third database, linked to the ERP system kept all other information including shipments, orders, quantity of product sold, material cost, etc. The world wide sales and ops planning department kept track of the Weighted Average Percent Error (WAPE) of their forecasts which is used as this analysis as a proxy for demand variation since it is demand variation which is the primary cause for forecast error. Some of this cost driver data for one product is plotted in Figure 4.6.



	1	2	3	4
Revenues	0.21%	0.12%	0.26%	0.06%
Quantity	0.37%	0.35%	0.59%	0.34%
ECO	6.00%	7.24%	7.64%	7.22%
Defective Product	0.74%	3.00%	7.45%	7.52%
Shipments	1.18%	1.43%	2.06%	1.52%
Demand Forecast Error	1.00%	1.00%	1.00%	1.00%

Figure 4.6 Sample Cost Driver Data

The cost driver information, when plotted as a percentage, together next to percent of revenue generated provides useful insight for managers: it provides a quantitative measure of the effort required to generate revenues for a particular product. For example, while this particular product represents less than 0.3% of the company's revenues, it can be seen that it represents much higher cost driver levels. In particular, this product represents nearly eight percent of the engineering change orders (ECO's), and between three and eight percent of the company's defective returns. It also represents over one percent of the demand variation and over one percent of the number of shipping transactions (includes inventory moves between warehouses). Managers were very interested in this presentation of data. Not only could they use it to allocate overhead cost and summarize the operational effort required to manage a particular product but it could also be used to provided clues as to where to delve deeper. For example, on this particular product, operations used the cost driver data to motivate a cross-functional effort to resolve the quality problems associated with this product.

Using the Cost Driver Data to Allocate Overhead

This cost driver information is used to allocate costs from each business activity to specific products. For each business activity, we can use the proportion of cost driver associated with each product to allocate activity cost to the product. For example, if 4 percent of the total number of defective returns for a period were for product X, then 4 percent of the quality management activity cost for that period would be allocated to product X. The following equation calculates the Quality Management activity cost is allocated to one product (product X): X_Q

$$X_Q = Q*d/D \qquad \textit{(Eqn 4.2)}$$

where Q is the Quality Management Activity Cost, d is the number of defective returns for product X and D is the total number of Defective Returns for all products.

Similarly, the proportion of other cost drivers generated by product X would be used to allocate overhead from each of the other business activities. The total amount of overhead allocated to product X, X_T, is simply the sum of all the business activity costs allocated to product X.

$$X_T = X_Q+X_{DL}+X_{NPI}+X_S+X_{INV}+X_{OF}+X_{OP}+X_{PL}+X_A \qquad \textit{(Eqn 4.3)}$$

Where X_Q is the Product X Quality Management Cost, X_{DL} is the Product X Direct Labor Cost, X_{NPI} is the Product X New Product Introduction Cost, X_S is the Product X Supplier Management Cost, X_{INV} is the Product X Inventory Management Cost, X_{OF} is the Product X Order Fulfillment Cost, X_{OP} is the Product X Operations Management Cost, X_{PL} is the Product X Production Planning Cost, X_A is the Product X Administration Cost

The ABC methodology is summarized schematically in Figure 4.7.

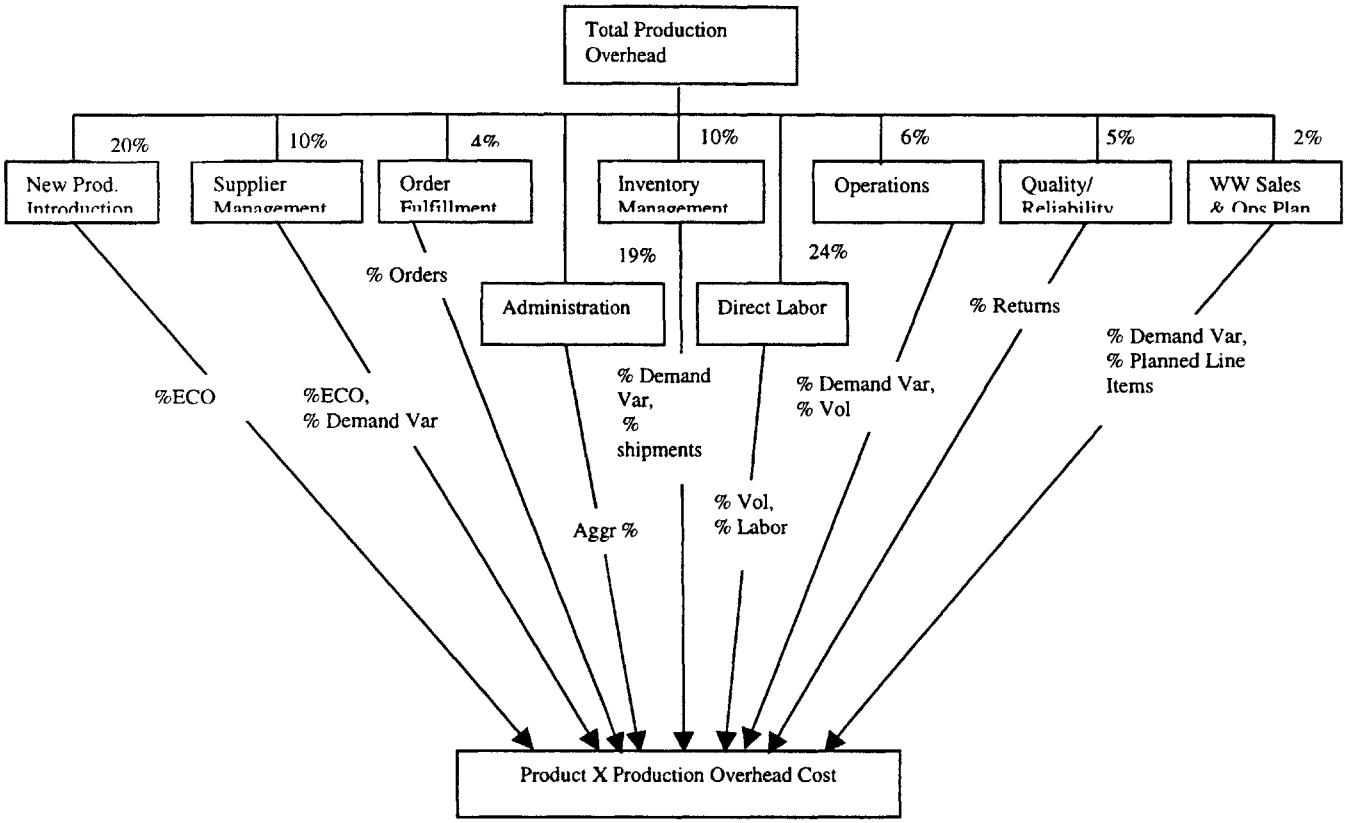
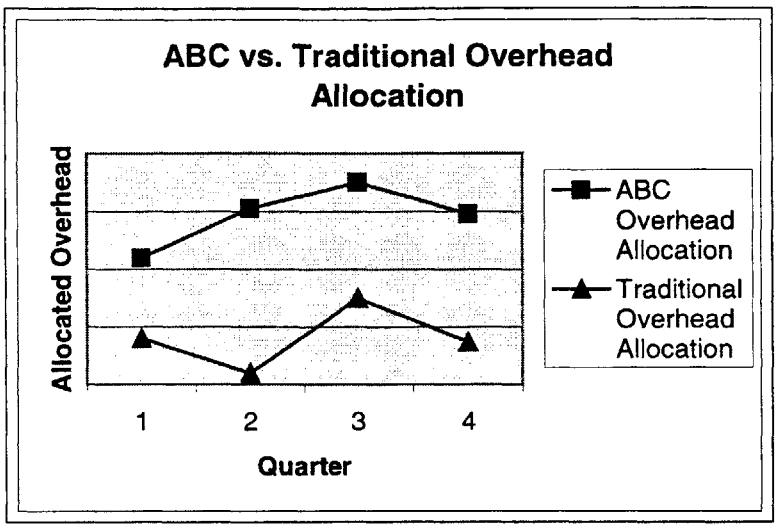


Figure 4.7 ABC Allocation to Product X

4.7 Results

Figure 4.8 shows production overhead for four consecutive quarters allocated to product X by the Activity Based Method, and the traditional system. As can be seen, the ABC system allocates significantly more overhead to this product than the traditional system allocates. This particular product was chosen because it was being considered for retirement. Although this product was not selling well, operations managers felt that quality problems and excess inventory associated with this product were costing the company more than indicated by the existing accounting system. The results of the ABC allocation confirm operations managers gut feeling.



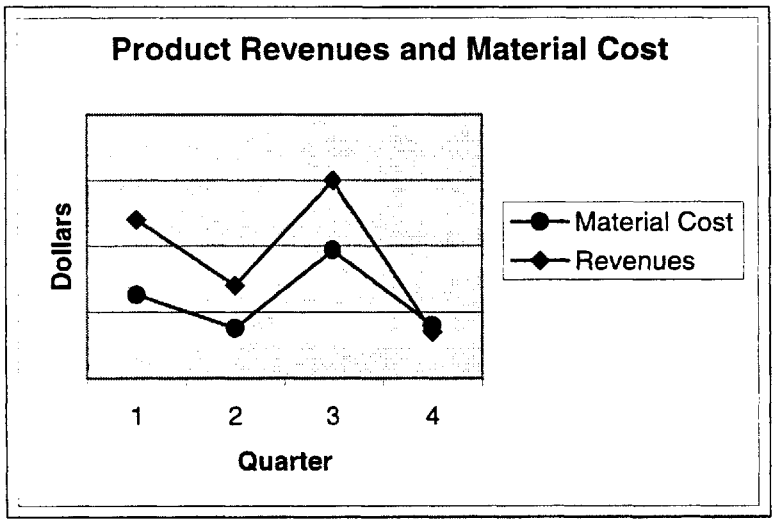


Figure 4.8 ABC vs. Traditional Cost Allocation

These results were also compared to a previous employee survey that quantified the amount of time spent on different products during a specific period. Table 4.4 shows the percent of total overhead allocated to this particular product by the survey, the ABC system and the traditional system. As can be seen, the results of the survey are much closer to the results of the ABC analysis than they are to the traditional system results.

Method	Overhead allocation
Employee Survey	4.3
ABC Analysis	3.1
Traditional System	.3

Table 4.4 Validation of ABC methodology

Another important observation is that the allocation of overhead by the traditional system clearly follows the amount of revenues generated by the product. This is to be expected since the traditional system allocates overhead on a percent of material basis and the material cost is charged to the product when revenues are generated by the sale of the product. The more sales of a product, the more material used, therefore, the more overhead charged.

On the other hand, overhead allocated by the ABC system does not correlate as well with the revenue curve. This is also expected since the drivers of overhead cost in this case include a mixture of things that do not vary with revenue like defective returns, demand variation, and engineering changes. Since products being considered for end of life are often characterized by low revenues it is important to capture elements of cost that do not correlate with revenue.

4.8 Summary

The activity based cost system is inherently a more accurate cost accounting system than the traditional system because it is based on cost drivers that more accurately reflect how people in the organization are spending their time. This is supported by the results presented here and by numerous examples in the management accounting literature. While ABC systems are often criticized for their complexity and difficulty in implementation, the system proposed here is quite simple and easy to implement.

At Bay Networks, a spreadsheet was created by the author where cost driver data (available from the various databases) and overhead allocation to activities (based on employee surveys) was input for any product. The spreadsheet would then calculate the activity-based cost for that product. Company finance personnel were trained to use this spreadsheet for future end of life projects. A system specification was also written to have company database programmers set up an automated link between the spreadsheet and the various databases. Once set up, this automated activity based cost system will require less management time than the existing accounting system. More

importantly the improved accuracy of the ABC system can result in significant improvement in business decision making. In the case of product X (used as an example in this chapter) the product cost information provided by the proposed activity based cost system enabled operations managers to open a dialog with product and sales managers. Although strategic considerations prevented the immediate retirement of product X, steps are being taken to improve the attractiveness and reduce the cost of product X.

5-CONCLUSIONS AND RECOMMENDATIONS

5.1 Product End of Life Management

Many companies do not have a product end of life process. They have no way to formally evaluate products nearing the end of their lifecycle to identify products that should be retired. Furthermore, after a product is launched, there is often no one group or person who is responsible for managing the rest of the product lifecycle. Finally, very little has been written in the area of how to systematically eliminate products without destroying customer relationships or disrupting the supply chain (Wind, 1982, Greenley and Bayus, 1994). Chapter Three of this thesis provides an organizational structure, decision making process, and step by step guide to effectively end of life products. A company can use this methodology in conjunction with the New Product Introduction process to keep resources and management attention focused on products that support the strategic direction of the company.

5.2 Product Profitability

Robert Kaplan and Thomas Johnston (1987) argue that "In this time of rapid technological change, vigorous global and domestic competition, and enormously expanding information processing capabilities, management accounting systems are not providing useful, timely information for the process control, product costing, and performance evaluation activities of managers." The cost analysis presented in Chapter Four supports this argument. In traditional cost systems, high volume, low complexity products subsidize low volume high complexity products.

Activity based cost systems, on the other hand, have been criticized for being overly complex and difficult to implement. For this reason, many companies are hesitant to adopt them. The increasing use of ERP systems, company intranets and powerful computer databases, however, greatly increase the ease of ABC implementation. While Cooper and Kaplan (1998) recognize this new opportunity in their article "The Promise and Peril of Integrated Cost Systems," there are few, if any, examples in the literature which provide a practical model where this is accomplished. Chapter Four presents such a practical activity based cost model that is used to more accurately assess resource use and overhead cost associated with individual products. Specifically, this information is used by Bay Networks to help make product end of life decisions. While product profitability is only one consideration among many when making these product disposition decisions, it is an important data point that enables a discussion of strategic tradeoffs associated with various options.

5.3 Challenges and Recommendations

The product end of life process has been implemented to retire over 100 products at Bay Networks and over 60 key people throughout the organization have been trained to use the process. Early results and feedback from line managers indicate that the process works. Several additional EOL teams have been formed at Bay Networks and even some of Nortel Network's other divisions have requested training in the process as they are starting their own EOL projects. The activity based cost model was also well received by finance, operations and product managers and was used to identify one product family that is significantly less profitable than previously thought. On that product, further investigation has been initiated to determine whether improvement efforts or product end of life is appropriate. Furthermore, as a result of this work, operations finance is considering replacing their current accounting system altogether and fully implementing an activity based cost system.

There remains, however, organizational resistance to retiring products. This resistance stems from incentive systems that discourage elimination of any revenue stream, emotional attachment to products and a low level of interest in retiring products relative to other more exciting activities such as new product development. Much effort remains to move the organization further along the end of life process learning curve. As with any improvement process, the EOL process requires continued high level support to ensure ongoing success. The following are some recommendations based on the author's observations while conducting the research that led to this thesis:

Fully Implement EOL management systems

At the conclusion of this study, the automated product tracking systems mentioned in sections 3.2 and 3.6 were still in development and had not yet been fully implemented. These tracking systems are critical to monitoring the effectiveness of the EOL process and ensuring that EOL projects maintain a high level of visibility and support from management. These tracking systems are key communications tools that will help keep EOL projects moving forward and encourage continuous improvement of the process itself.

Provide incentives that are in line with company goals

Many companies have set up incentive systems that run counter to the goals of the organization. At Bay Networks, there was some sentiment that functional groups rewarded on the basis of revenues generated would be hesitant to eliminate products regardless of profitability. It could also

be argued that functional organizations measured on a basis of cost might be over zealous in taking cost cutting measures, even at the detriment of the company as a whole. Transitioning to an activity based cost accounting system which enables a more accurate assessment of product profitability and setting up incentive systems that encourage profit maximization for the company as a whole would help ensure a profit maximizing product portfolio.

EOL should be thought of as a continuous process.

The end of life process should not be used only as a one-time product portfolio streamlining tool. As technology continues to change, product lifecycles shorten, and new products are introduced at an increasing rate, the EOL process will need to be continuously implemented to maintain a lean product portfolio. Implementation of the EOL management systems and profit measurement and incentive systems as mentioned above should help ensure that the EOL process is not forgotten once the initial management attention is turned elsewhere.

5.4 Areas for Further Work

Effective product lifecycle management is only one step toward simplifying the product portfolio. For most companies, increasing product variety is a necessary part of growth. In order to keep costs low and quality high while offering a broad product portfolio, companies should make use of product platforms and design for variety techniques. In "The Power of Product Platforms," Meyer and Lehnerd (1997) explain that product platforms can be used to leverage product subsystems across the various price/performance levels and technologies in the marketplace. (See Appendix 3 for a summary of Meyer and Lehnerd's concept as it applies to Bay's product portfolio.) Standardization, modular architecture, and part commonality can be used to speed up product development, cut costs and improve product quality.

Some areas for further study relating to Bay Networks product portfolio include:

- An assessment of the level of part commonality across the product portfolio. Kota and Sethuraman (1998) present a simple yet powerful method for measuring commonality. They calculate a Product Line Commonality index (PCI) as a measure of the extent to which various products share components. Ishii and Martin (1996) present a similar methodology. In either case, this information could be gathered and used to benchmark Bay against its competitors. It could also be used to track progress as Bay starts to implement common platforms across product lines.

- An assessment of the risks and challenges that can be expected as Bay Networks implements standardized design practices across its various business units and design groups. The result of this study might include a recommended approach or process for managing the cultural barriers and mitigating potential risks.

- An investigation of the total potential cost saving associated with implementing product platforms across the product portfolio. Quantifying the total benefit of using product platforms in dollar terms would help motivate the company to accelerate its efforts in this area.

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APPENDIX 1: END OF LIFE PROCESS CHECKLIST FOR WORLDWIDE OPERATIONS

The following is a checklist that outlines the Worldwide Operations tasks required to End of Life a product. Program managers are to use this project plan/checklist to help manage the EOL process. Functional groups within Worldwide Operations should review the project plan/checklist and understand their responsibilities to the EOL team.

No.	Task Name	Resource Responsible	Complete
1	EOL Process Decision Making	Program Manager/Product Manager	Yes/No
2	Triggers Initiated (see list of possible triggers)	WW Sales and Ops Planning/Product Manager	Yes/No
3	Preliminary WIP Analysis	Materials/Mfg Finance	Yes/No
4	Preliminary Supply Demand (forecast) Analysis	WW Sales and Ops Planning/Product Manager	Yes/No
5	Check to ensure there are no contract obligations preventing EOL	Product Management/Contracts	Yes/No
6	Check to ensure there are no other products which depend on this product	Test Engineering	Yes/No
7	Product Substitute List Defined	Product Manager	Yes/No
8	EOL Decision ratified, process initiated	EC/Finance	Yes/No
9	Develop firesale Plan to minimize fiscal exposure.	Product Manager / Marketing/ Product Line controller	Yes/No
10	Execute Special Offers	Sales/Finance/Sales/Product Management	Yes/No
11	EOL Process Communications	Program Manager	Yes/No
12	Last Ship, Last Order, Last Return, SAP01-05, Price List discontinuation dates communicated to team	Program Manager	Yes/No
13	Channel Announcement	Product Management/Price List	Yes/No
14	Archive Process communicated	Engineering Services	Yes/No
15	Supply Base Communications	Materials/Matl Prog Mgrs	Yes/No
16	SAP system updated to OBS 01, Price List Discontinuation Warning	Eng Svcs ECO/Price List	Yes/No
17	Reman Price List Updated	Reman Marketing	Yes/No
18	"New" Discontinued Visibility on Reman Price list	Reman Marketing	Yes/No
19	Recall Sales Office Equipment	Product Management	Yes/No
20	SAP system updated to OBS 02, Remove from Price List, Last Order date defined (60 to 120 days)	Eng Svcs ECO/Price List	Yes/No
21	SAP system updated to OBS 03, Last Ship Date	Eng Svcs ECO/Price List	Yes/No
22	QCD reporting, when no longer tracked back to supplier	Supplier Engineering	Yes/No
23	Demand Assessment	WW Sales and Ops Planning	Yes/No
24	Forecast through last ship date (revenue/non	WW Sales and Ops	Yes/No

No.	Task Name	Resource Responsible	Complete
	revenue)	Planning	
25	Analyze New Order Forecast that was created based on EOL Plan	WW Sales and Ops Planning/Product Management	Yes/No
26	Analyze data from Sales Team	WW Sales and Ops Planning/Sales	Yes/No
27	Analyze Product Replacement Strategy integrated into Mfg process	WW Sales and Ops Plan/Product Management	Yes/No
28	Logistics Last time buy forecast	Logistics Planner	Yes/No
29	Repair or replace strategy/plan defined	Reman	Yes/No
30	Forecast spares requirements based on install base and return history	Logistics	Yes/No
31	Integrate Contract Obligations with Channel (length of time,returns policy)	WW Sales and Ops Planning/Product Manager/Legal	Yes/No
32	Channel Sell Through Identified in Information Warehouse	WW Sales and Ops Planning	Yes/No
33	Channel FGI counted in Information Warehouse	Order Admin/WW Sales and Ops Planning	Yes/No
34	Forecasted Dist/VAR/Reseller returns	Order Fullfillment/WW Sales and Ops Planning	Yes/No
35	Eval units in field count from SAP inventory report	Sales Finance/ Product Management /WW Sales and Ops Planning	Yes/No
36	Policies developed for outstanding Evals (Pay up or Return)	Sales/Product Management/Sales Finance	Yes/No
37	Supply Assessment	Master Production Schedulers	Yes/No
38	Critical Component List Generated/Execute Purchases	Materials/Engineering Services	Yes/No
39	Analyze Unique Part List to determine exposure or EOL supply requirements	Master Production Schedulers/Materials	Yes/No
40	Minimum Buy assessment	Materials/Commodity Mgt	Yes/No
41	Analyze non-unique parts and re-optimize targeted inventory goals	Materials	Yes/No
42	Inventory Analysis	Materials	Yes/No
43	Contract Manufacturer's FGI and WIP	Materials	Yes/No
44	Bay Production FGI and WIP	Materials	Yes/No
45	Bay Reman FGI and WIP	Reman	Yes/No
46	Bay Logistics FGI	Logistics	Yes/No
47	Open Purchase Order Review	Materials	Yes/No
48	Translate WIP/Component Inventory to FG Equivalents	Materials	Yes/No
49	Ongoing Supply/Demand Assessment	WW Sales and Ops Planning/MPS	Yes/No
50	Periodic Financial report/EOL Financial Impact	Mfg Finance	Yes/No
51	Open Backlog Report	Order Fullfillment	Yes/No
52	Monitor Channel Inventory	WW Sales and Ops Planning	Yes/No
53	Propose Financial Reserve	Manufacturing Finance	Yes/No
54	Production Planning and Last Time Build Plan	Production/Materials	Yes/No
55	Last Order Date(60 day min, 120 day max)	Order Admin	Yes/No
56	Logistic Component Requirements Identified	Customer Svcs/Logistics	Yes/No

No.	Task Name	Resource Responsible	Complete
57	Logistic Last Time Buy	Customer Svc/Logistics	Yes/No
58	Last Manufacturing Build Plan Completed	Production	Yes/No
59	Last Manufacturing Purchases Completed	Materials	Yes/No
60	Last Manufacturing Build	Production	Yes/No
61	Inventory Disposition	Inventory Mgt/Materials	Yes/No
62	Capital Asset Tag Disposition	Manufacturing Finance/Man. Engrg	Yes/No
63	Archive Process Documents	Engineering Svcs	Yes/No
64	Contract Manufacturing System Assy & Test Documents archived	Test Engineering/Supplier Engineering	Yes/No
65	Bay Process System Assy &Test Documents archived	Test Engineering/Mechanical Engineering	Yes/No
66	Test Scripts documented and archived	Test Engineering/Supplier Engineering	Yes/No

APPENDIX 2: ACTIVITY DICTIONARY AND COST DRIVER SELECTION

1.) **Direct Labor (~24% of total O/H cost):** All full time and contract direct labor used in assembling a product in house. If a product is assembled externally, then no Direct Labor is allocated. Since the company does not keep track of direct labor spent on each product, we need to allocate it to product.

The three main activities are:
Assembling Boards and Boxes
Packaging and adding documentation
Rework

Selected Cost Driver
If product is assembled in house then use estimated labor content. Estimated Labor content is calculated using labor standards (labor hours per unit manufactured) multiplied by total number of units manufactured.
If product is assembled at contract manufacturer then assume no direct labor.

2.) **New Product Introduction (~20% of total O/H cost):** All activities within operations pertaining to developing and launching a new product. A new product might mean a completely new product or a product line extension. This includes engineering reviews, phase reviews, prototype test and build, pilot test and build, NPI materials management, and production line process development and scale up.

The three main activities are:
Production Line Process Development
Phase Review Process
Engineering Reviews

Selected Cost Driver
Engineering Change Orders

3.) **Supplier Management (~10% of total O/H cost):** All activities related to managing the supply base for products. This includes all effort to manage both commodity components and management of contract manufacturers. A large part of this effort is managing inventory levels due to demand fluctuation, and administering Engineering Change Orders through supply base.

The three main activities are:
Supplier Business Management
Emergency Response
Supplier Surveys and appraisals

Selected Cost Drivers are
ECO's (50%)
Demand Variation as measured by Weighted Average Percent Error (WAPE) (50%)

4.) **Order Fulfillment (~4% of total O/H cost):** All activities related to booking orders, tracking those orders through production and responding to customer calls and issues.

The three main activities are:
Respond/Resolve Customer Calls and issues
On Time Delivery Tracking
Booking Orders

Selected Cost Driver
Number of Orders/Invoices

5.) **Inventory/Material Management(~10% of total O/H cost):** All activities related to scheduling and planning raw material flow, assessing and managing inventories, reducing lead times, and dispositioning excess and obsolete material.

The three main activities are:
Planning and Procurement
Physical Inventory and Cycle Counts
Offsite Inventory Storage and Management

Selected Cost Drivers
Number of Shipments (50%)
Demand Variation as measured by Weighted Average Percent Error (WAPE) (50%)

6.) **Operations (~6% of total O/H cost):** All activities related to supporting internal production and remanufacturing. This includes production process development, expediting material on the assembly floor, daily firefighting, administering returns, stock rotation, troubleshooting, repair of DOAM.

The three main activities are:
Emergency Response
Production Support Process Development
SAP material transactions

Selected Cost Drivers
Unit Volume (50%)
Demand Variation as measured by Weighted Average Percent Error (WAPE) (50%)

7.) **Quality and Reliability (~5% of total O/H cost)**: All activities related to quality data collection and analysis, failure analysis and reporting, research and testing to resolve customer issues either in the field or in house. Also quality audits prior to shipment of product to customer.

The three main activities are:
Quality Reporting and Analysis
Problem Resolution/Customer Response
Quality Audits

Selected Cost Driver
Number of Defective Returns

8.) World Wide Sales and Production Planning (~2% of total O/H cost): All activites related to assessing the demand for product and then planning production.

The three main activities are:

Quarterly Demand Planning
Plan monitoring and schedule re-planning
Revenue management

Selected Cost Driver

Demand Variation as measured by Weighted Average Percent Error (WAPE) 50%
Product Line Items Planned for product 50%

9.) Administration (~19% of total O/H cost): All activities by managers to administer performance reviews, hold meetings, write memos, email, voicemail, weekly status reports, special reports, etc.

The three main activities are:

Management
Meetings
General Documentation and Administration

Selected Cost Driver

Aggregate proportion of all other cost drivers

APPENDIX 3 USING PRODUCT PLATFORMS (AND DESIGN FOR VARIETY) TO MINIMIZE THE IMPACT OF PRODUCT PROLIFERATION

A3.1 Introduction

While an End of Life process will help to prevent product proliferation by eliminating strategically superfluous products, it does not minimize the remaining portfolio complexity surrounding the company's key products. "In a growing enterprise, an expanding product portfolio is a fact of life" (Meyer and Lehnerd 1997). Even after eliminating all of the low volume, strategically irrelevant products, Bay Network's goal of offering end-to-end networking solutions will continue to require significant variety in its product offering. Meyer and Lehnerd (1997) propose that product platforms can be used to reduce complexity and cost across the product line and speed up product development cycle time. This appendix is a summary of Meyer and Lehnerd's book: The Power of Product Platforms and is included as a starting point for possible follow on work.

A3.2 Platform Market Grid

Meyer and Lehnerd (1997) suggest using a platform market grid to evaluate a product portfolio and consider alternative platform strategies. In this grid, major market segments are arranged horizontally and on the vertical axis are the different tiers of price and performance. We can use such a grid to gain insight into Bay Networks product portfolio and identify areas of opportunity for improvement. Since Bay manufactures products focused on four different networking technologies we have arranged the products according to technology sectors instead of market sectors.

Price/Performance Tiers					
	Carrier/Large Enterprise	System 5000 →	Centilliion 1000	BCN/BLN	Contivity Extranet →
	Mid Sized Enterprise	Dist 5000	C100 C50 Baystack 450 ←	ASN Accelar 1100	Contivity Extranet Versalar 8000 RAC
	Workgroup	Baystack	Baystack 350 Baystack 303,304	ARN, AN/ANH Marlin Nautica 4000	Contivity Extranet RA 2000/4000
	Remote Office/Home Office	↓		Nautica 200 Nautica 250 Clam	Instant Internet Lan City
		Shared Media	**Switch**	**Router**	**Remote Access**
	Technology Segments				

Figure A3.1 Data Networking Product Platform Market Grid

From this platform market/technology grid a few observations can be made. First of all there are a large number of product platforms, with some segments having multiple platforms. If Northern Telecom's data networking products were added to this grid, there would be a significantly larger number of platforms. The End of Life process described in Chapter 3 will help to identify and eliminate non-value-added multiplicity of product platforms.

Second, most of the segments are filled with what Meyer and Lehnerd (1997) call niche-specific products. In total there are over 28 different platforms which cover the 16 different segments. In general, the product platforms are not used across technology segments or price/performance tiers.

Meyer and Lehnerd (1997) explain that the cause of this niche specific product strategy can be that "each product development group is totally focused and dedicated to serving the needs of a very specific niche. Seeking to build the perfect product for each new customer group, engineers lead the corporation away from commonality. Each time a new customer request is formalized, new parts are added to achieve the optimum solution without consideration of the downstream costs of the decision. The engineer, or the engineering manager, rarely gets wind of those costs. As the components of the firms products proliferate...opportunities to achieve economies in procurement diminish" (Meyer and Lehnerd, 1997). This is the situation at Bay Networks. Since the company has grown largely through acquisition of smaller companies, each acquired company brought with it, its own product platform and an engineering team with its own design philosophy. In an attempt to maintain the creative environment of a startup company, Bay hesitated to standardize its design practices across the company. In addition, time to market and product performance pressure continue to be used as an argument for optimizing each product design with relatively little attention given to part commonality across platforms.

A3.3 Use of Product Platforms

Bay Networks is the number three player (3 Com is number two in revenues) in an industry dominated by Cisco Systems. Convergence with the telecommunications industry will only increase competition with formidable companies like Lucent Technologies entering the arena. In order to gain on and compete with these giants, Bay must be able to bring the most advanced technology to market faster, with higher quality and at lower cost than its more widely recognized competitors. Effective use of product platforms can help Bay to accomplish this goal.

Meyer and Lehnerd (1997) define a product platform as a "set of subsystems and interfaces that form a common structure from which a stream of derivative products can be efficiently developed and produced." Figure A3.2 demonstrates this concept.

In figure A3.2, subsystems are labeled S1, S2, S3, etc. Each subsystem within a platform has a specific function that in different combinations can form a number of derivative products within the platform. A platform extension is created when one or more of the subsystems undergoes substantial improvement, while the total number and type of subsystems remains unchanged. Improved subsystems are labeled in Figure A3.2 with an asterisk (ex S1*). This platform extension may manifest itself as a lower cost or higher performing product line.

A new product platform is a new combination of subsystems and interfaces representing a new architecture. In this case, some subsystems and interfaces from prior generations may be reused and combined with new subsystems and interfaces in the new platform architecture.

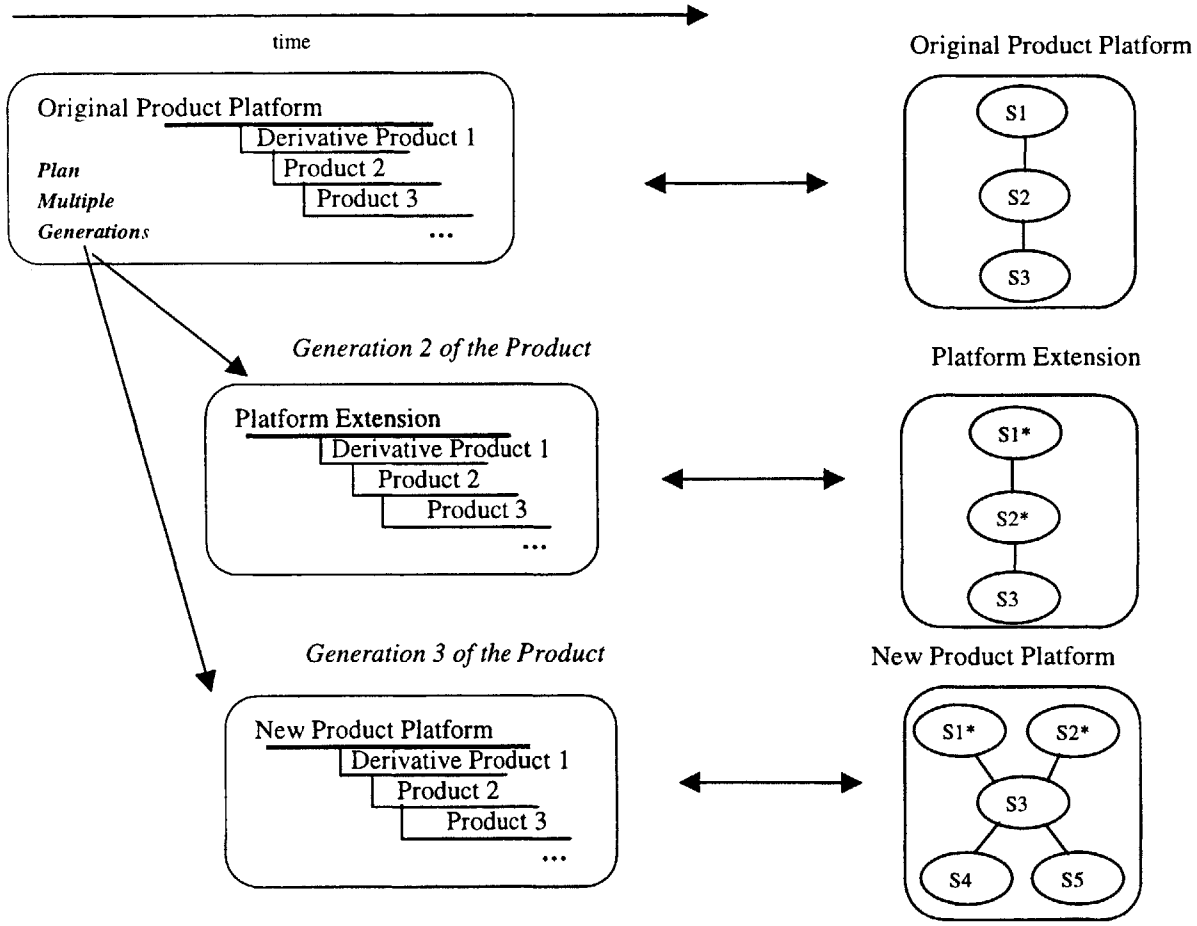


Figure A3.2 Use of Subsystems across Platforms

A3.4 Leveraging Key Platform Subsystems

Product platforms and their key subsystems can be leveraged *horizontally* across markets and technologies or *vertically* across multiple price performance tiers to minimize complexity while providing product variety. Figure A3.3 demonstrates a theoretical example how a few of Bay's product lines might be leveraged across all technology segments and price/performance tiers to simplify the product portfolio. This would allow the company to eliminate many of the other platforms and their associated components. While there may be technical or business reasons why this particular arrangement may not be optimal or possible, it is meant only to illustrate the concept.

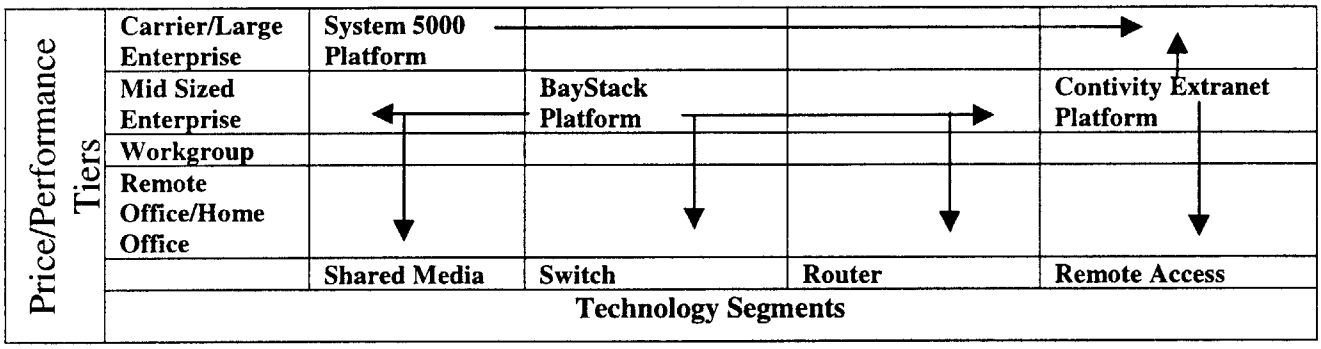
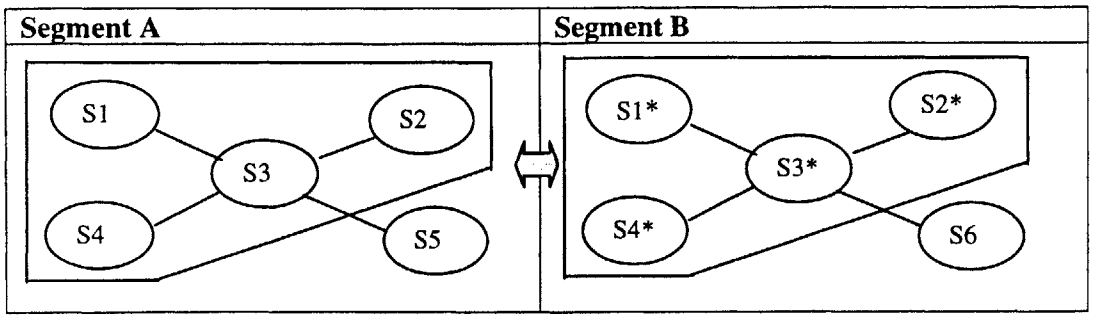


Figure A3.3 Potential Platform Market Grid

A3.4.1 Horizontal Platform Leverage

For example, it may be possible to leverage the BayStack platform horizontally across different technology segments. Since many of Bay Network's routers, switches, hubs and remote access equipment for mid sized enterprises all are typically designed to fit into a rack mount system, they are typically about the same size and shape. Currently, most product groups design a new "box" for each new product. A "box" is typically a sheet metal enclosure which houses the circuit boards, power supplies, cooling systems, etc that make up a product. It would be possible to leverage the same "box" horizontally across all four technologies rather than designing a new box for each product. Other subsystems such as cooling systems, power supplies, and memory boards could be leveraged horizontally as well. Figure A3.4 shows schematically how subsystems can be shared across multiple segments.

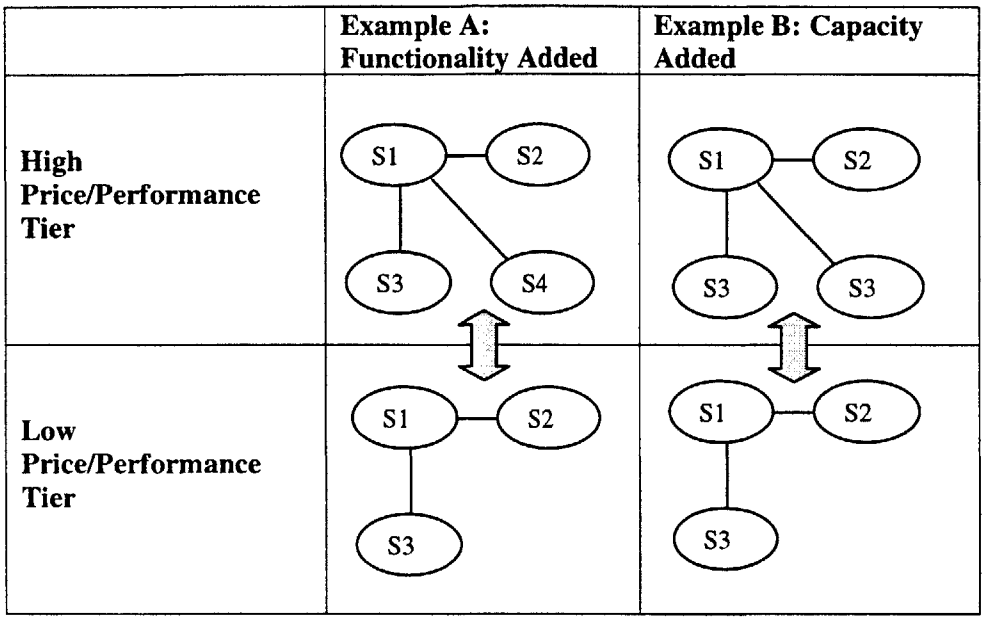


Horizontal Platform Leverage: A group of key subsystems are reused, across technology/market groups

Figure A3.4 Horizontal Platform Leverage

A3.4.2 Vertical Platform Leverage

Product platforms and subsystems can be leveraged vertically as well. As you move vertically upward to higher price/performance tiers, products tend to get bigger and have more features, communication ports and memory than lower levels. To leverage vertically, it would be possible to create a modular architecture that allows a wide range of performance levels. For example, different price performance levels could be achieved by installing a different numbers or types of boards, memory chips, or ports. In some cases, a variety of performance levels could be attained simply by installing different software versions. Bay has recently implemented this vertical leverage strategy in is BayStack 450 platform. By removing certain components from the 450 platform, Bay can create a lower end product that they can use to replace the existing Baystack 350 platform. The Bay Stack platform and other key platforms could be leveraged further to cover each of the price/performance tiers in each technology while greatly reducing the number of unique parts in the product portfolio. Figure A3.5 shows two examples of how subsystems are shared in the case of vertical platform leverage



By adding or deleting components can move vertically across Price/Performance Tiers.

Figure A3.5 Vertical Platform Leverage

A3.5 Benefits of Vertical and Horizontal Platform Leverage

Leveraging product platform systems horizontally and vertically would have would have significant benefit to the firm.

- **New Product Development**

Product development time could be reduced since the product development team would not have to "reinvent the wheel" every time they introduced a new product. Furthermore, if a product group can improve a particular subsystem to provide a significant functional advantage over competitors, all products that use that subsystem will benefit.

- **Ramp up and Production**

Planning and Inventory Management

As shown by Roza (1998), use of common subsystems across multiple products allows for demand pooling and reduces the need for inventory, and capacity planning both at Bay Networks and at their suppliers. As shown in Chapter 4, demand variation is a significant driver of cost within Bay Networks manufacturing operations.

Purchasing

With larger volumes of fewer components, better pricing for materials can be negotiated.

Manufacturing Operations

Manufacturing setup costs between production runs are reduced when products share similar subsystems. Also retooling costs are reduced when new products are introduced that share similar components.

Quality

Standardizing on fewer platforms and subsystems should improve quality. For example, a number of quality problems at Bay Networks center around mechanical systems such as the cooling systems. These mechanical systems understandably take a back seat in the design process relative to the design of the electronics systems and are as a result often sub-optimal. Examples of quality problems in this area include excessive fan noise, and tolerance stack up problems that requires special steps in the assembly process to bias component placement in a particular direction. By standardizing on a few mechanical designs, those designs can be perfected and optimized for manufacturing. Since mechanical design is not much of a differentiator in the eyes of the customer, it should not matter to the customer that many products look alike.

End of Life

When a product is retired, massive write-offs of specialized inventory, tools and equipment is reduced since the remaining products with common platforms and subsystems continue to use many of the same parts, and processes. This allows the organization to be able to be flexible and avoid being tied to dying products.

A3.6 Summary

The benefit of retiring poor performing products is just the beginning of streamlining the product portfolio. The next, perhaps more important step is to leverage a few product platforms across the product portfolio to minimize complexity and cost while providing the variety demanded in the marketplace. As Bay's product groups work more closely together to standardize product architecture and share common subsystems, older platforms can be retired. Efficient use of product platforms in combination with the product end of life process will keep the product portfolio lean and flexible.