

End-of-Life Cycle Product Management

By

Gokhan Usanmaz

M.S. Operations Research & Industrial Engineering
University of Texas at Austin, 1994

B.S. Industrial Engineering
Istanbul Technical University, 1990

Submitted to the Engineering Systems Division
in partial fulfillment of the requirements for the degree of

Master of Engineering in Logistics

at the

Massachusetts Institute of Technology

June 2000

© 2000 Gokhan Usanmaz
All Rights Reserved

The author hereby grants to MIT permission to reproduce and to distribute publicly paper
and electronic copies of this thesis document in whole or in part.

Signature of the Author.....

Engineering Systems Division
May 5, 2000

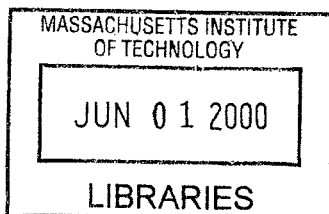
Certified by.....

James Masters
Executive Director, Master of Engineering in Logistics Program
Thesis Supervisor

Accepted by.....

Yossi Sheffi

Director, Master of Engineering in Logistics Program



ENG

End-of-Life Cycle Product Management

By

Gokhan Usanmaz

Submitted to the Engineering Systems Division on May 5, 2000 in partial fulfillment of the requirements for the degree of Master of Engineering in Logistics

ABSTRACT

Market leadership requires effective management of product life cycle, starting from the launch of a new product until its retirement. In this particular project, an exploratory study of business practices in the management of products in the decline phase and the eventual decision of product abandonment is conducted through surveys and interviews of senior executives from Fortune 500 companies, focusing mainly on food, networking equipment, medical devices, consumer electronics and retail industries. Actual names of the companies are not revealed for confidentiality reasons. Also, the implementations, assumptions and level of acceptance of decision support system (DSS) modules on product lifecycle management are analyzed. Finally, companies' business processes are compared and enhancements to current DSS systems are proposed.

Thesis Supervisor: James Masters

Title: Executive Director, Master of Engineering in Logistics Program

Dedication

I would like to dedicate this work to my wife Ebru for her sacrifice, support and love throughout his studies in MIT. This work would not be materialized without her patience. She is my greatest inspiration...

I would like to thank our families for all their support and understanding. Particularly, I wish to acknowledge the influence of my parents on me while they were bringing me up with the pursuit of perfection, integrity and ultimately being a virtuous person.

I would also like to acknowledge the most helpful guidance of James Masters and Jonathan Byrnes during this study. It is a privilege to be associated with superb instructors like them.

TABLE OF CONTENTS

1. The Product Life Cycle Concept	
Introduction.....	7
1.1. An Important Aspect of Strategic Product Management.....	10
1.2. Forgetting the Product Life Cycle Concept.....	12
1.3. The Market Share/Growth Matrix.....	14
1.4. The Company Position/Industry Attractiveness Screen.....	17
1.5. The PIMS Model.....	19
2. Frameworks to Manage Declining Products	
2.1. End-of-Life Cycle Product Selection in Product Portfolio Management.....	22
2.2. Supply Chain Management.....	25
2.3. Product Life Cycle and Supply Chain.....	29
2.4. A New Paradigm: Spontaneous Built-to-Order.....	32
3. Industry Practices On Management of End-of-Life Cycle Products	
3.1. Networking/Telecommunications Equipment Industry.....	35
3.2. Medical Devices Industry.....	40
3.3. Consumer Electronics Industry.....	44
3.4. Food Industry.....	49
3.5. Retail Industry.....	55
4. Software Support for Management of Declining Products	
4.1. Product Life Cycle Management Software.....	64

4.2. Future trends.....	68
4.3. Proposed Enhancements.....	70
5. Conclusion.....	72
References.....	75
Appendix: End-of-Lifecycle Management Survey Form.....	78

LIST OF FIGURES AND TABLES

Figure 1. Product Life Cycle Stages of Various Products in Consumer Electronics....	10
Table 1. Product Life Cycle Characteristics during Introduction, Growth and Maturity Stages.....	11
Table 2. Product Life Cycle Characteristics during Decline and Termination Stages..	12
Figure 2. Boston Consulting Group’s Market Share/Growth Matrix.....	15
Figure 3. GE/McKinsey Company Position/Industry Attractiveness Matrix.....	18
Figure 4. Misalignment of Demand and Supply During PC Product Life Cycle.....	28
Figure 5. Extending Product Life Cycle.....	33
Figure 6. Web Enabled Distribution Channels of Company A.....	37
Figure 7. Web-enabling Company A.....	39
Figure 8. New Product Launch Initiatives Dealing with Chronic Excess Inventory....	42
Figure 9. ECR Improvement Concepts.....	54
Figure 10. Reaching to customers in Company F.....	56
Figure 11. Supply Chain Management at Company F.....	57
Figure 12. Evaluation for Decision Support Tools.....	68
Figure 13. Declining Product Management Business Process.....	73

1. THE PRODUCT LIFE CYCLE CONCEPT

INTRODUCTION

The final phase of a product's life, which is as important as its introduction to market, must be managed to avoid loss of profits and damaged relationships. For well-orchestrated product discontinuance, marketing, customer service & support, sales, supply chain management, manufacturing, and engineering must each play a part in developing and executing an integrated plan. The potential for excess and obsolescence must be assessed and mitigated. Having said that, in a business environment where technological evolution is gaining speed and product proliferation is necessary to satisfy ever-increasing customer demands, it becomes increasingly difficult to diagnose those products that are declining. In fact, the lack of management of these types of products, especially in high-tech, retail and apparel industries, can severely limit the profitability of companies resulting in obsolete inventories and subsequent write-offs.

A framework of declining product management in a firm could be established as follows:

First, it is important that a set of criteria be established to identify weak products and the frequency of evaluation. Business strategy, corporate objectives and business environment should be carefully assessed, and responsible parties should make sure that the diagnostic measures are aligned with them.

Secondly, all of the firm's SKUs, products and product lines should be evaluated to determine which ones are in the decline phase of their life cycle using previously determined metrics and forecasts. At this stage, possible alternate strategies such as product repositioning should be considered.

Finally, necessary changes should be made in marketing, finance, R&D and ultimately in supply chain management, with potential removal of the product/product groups. As an example, a firm may choose to use a different type of materials management or logistics

system for the slow-moving items: they can be stocked centrally or transported differently. Similarly, one may use a simple forecasting policy such as average demand or try to come up with a probability distribution function for the next forecast. An abandonment strategy should be chosen amongst a number of scenarios: immediately dropping, “harvesting” the products without any further investing on them, and soon.

The implementation of Enterprise Resource Planning (ERP) systems in recent years greatly facilitated the collection of business statistics in companies while allowing them to run fast and frequent diagnostics on thousands of SKUs. More importantly, the upcoming DSS modules, that use data provided by those ERP infrastructures, promise an integrated, cross-functional management of product lifecycle. It is safe to say that today’s powerful servers have enough horsepower to support the ever-demanding DSS software.

The subsequent chapters will try to shed light on the following questions related to the management of declining products:

- Are the companies recognizing the need to aggressively manage declining items in different industries?
- Who are the individuals responsible for identifying declining products and making the decisions about their management throughout the supply chain and possible abandonment?
- What are the business processes across different industries? What are the similarities if any?
- What are the data sources and criteria used to diagnose declining products?
- What are the data sources and criteria used to abandon products?
- What are the marketing, finance and supply chain management impacts associated with declining/abandoned products?
- What is the level of penetration of ERP and DSS tools in product lifecycle management (PLM)?
- How can we further improve the software support?

In Chapter 1, the concept of product lifecycle will be analyzed. This concept provides a framework for grouping products into homogenous families where similar marketing channel acceptance, advertising budgets and production/inventory policies can be established while integrating a set of assumptions about the time-dependent behavior of product designs, production processes and market participants. Marketing, sales, finance, production and logistics elements of different product lifecycle stages are also discussed. As an alternative concept, a brand-focused counter-approach where the validity of product lifecycle model is questioned is also reviewed. Finally, normative models to develop product management strategies, such as the PIMS model, the BCG growth/market share matrix and the market attractiveness/competitive capability matrix, are briefly analyzed.

In Chapter 2, a literature review is provided to give insights about the models, methodologies and procedures that have been advocated for use in the management of declining products. The decision criteria of each model are summarized together with their strengths and weaknesses. Finally, a new normative model will be proposed with a supply chain point-of-view.

In Chapter 3, the results from the interviews and surveys are discussed mainly around consumer electronics, retail, medical device and food industries. These industries provide striking differences in terms of management of slow moving inventory, but, more importantly, large companies from these sectors were willing to participate to this study.

In Chapter 4, the current software support is evaluated together with new trends and directions. Potential enhancements are also proposed.

Finally, conclusions will be outlined in Chapter 5 together with future research opportunities.

1.1 An Important Aspect of Strategic Product Management

The product life cycle can be the key to successful and profitable product management, from the introduction of new products to profitable disposal of obsolescent products, which is one of the main areas of interests of this study. The fundamental concept of the product life cycle (PLC) in consumer electronics industry can be illustrated as follows:

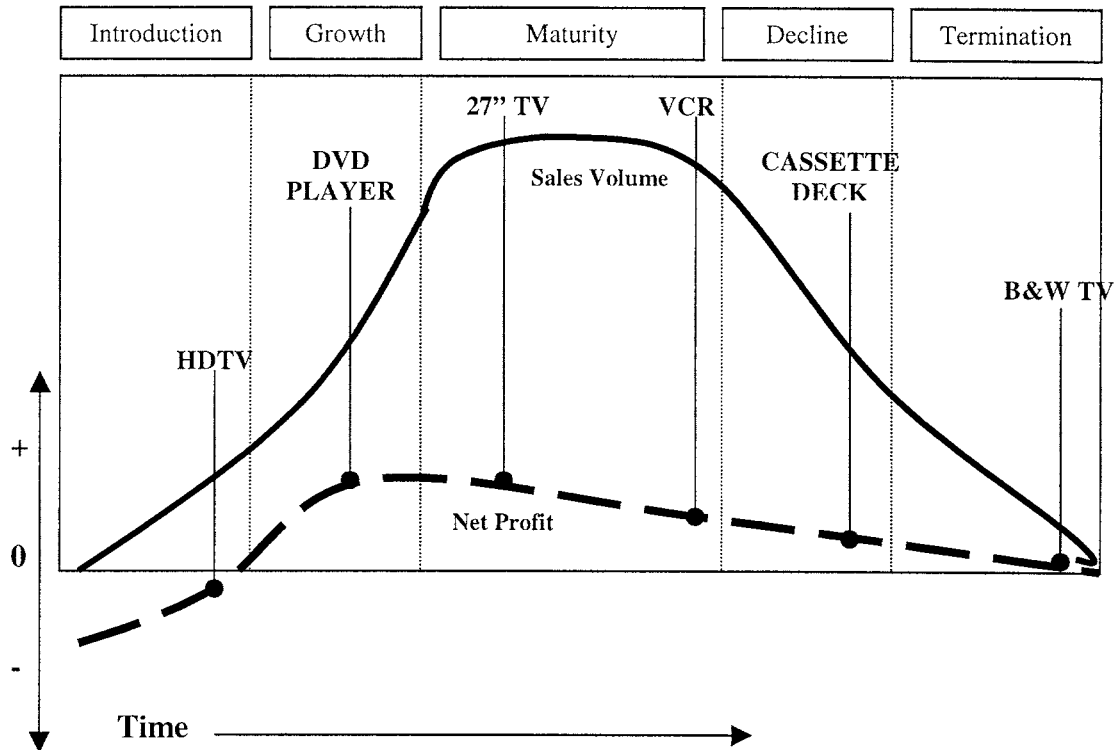


Figure 1. Product Life Cycle Stages of Various Products in Consumer Electronics

Most products follow a five-stage product life of introduction, growth, maturity, decline and termination. Product sales follow an evolutionary process, which initially begins with a slow ramp up in the introduction stage, with sales growth peaking in maturity, and sales drop during the decline stage. During the introduction stage low sales volume and high product introduction costs prevent companies from making net profits, although this may vary widely from one industry to another. As the sales and production increases, unit overhead and production costs decreases providing profitability for firms. The product's profits reach their highest levels somewhere between growth and maturity

depending on many factors such as competitors' action, production function characteristics, quality improvements and customer preferences. In the maturity stage, the marketing and production costs may increase due to efforts in maintaining the market share while providing more diversified products. In turn, this may affect the profits in a negative way and declining profits may cause weak firms to withdraw from the market. Unless most firms/competitors leave the marketplace, product profitability and sales will most likely suffer during the decline stage.

General characteristics of the products and their markets can be summarized in Table 1 and Table 2. (Smallwood, 1973)

	INTRODUCTION	GROWTH	MATURITY
MARKETING			
Customers	Innovative/High Income	High Income / Mass Market	Mass Market
Channels	Few	Many	Many
Approach	Product	Label	Label
Advertising	Awareness	Label Superiority	Lowest Price
Competitors	Few	Many	Many
PRICING			
Price	High	Lower	Lowest
Gross Margins	High	Lower	Lowest
Cost Reductions	Few	Many	Slower
Incentives	Channel	Channel / Consumer	Consumer / Channel
PRODUCT			
Configuration	Basic	Second Generation	Segmented / Sophisticated
Quality	Poor	Good	Superior
Capacity	Over	Under	Optimum
SUPPLY CHAIN			
Coordination	Flexible	Tightly Coordinated	Good coordination

Table 1. Product Life Cycle Characteristics during Introduction, Growth and Maturity Stages

	DECLINE	TERMINATION
MARKETING		
Customers	Laggards / Special	Few
Channels	Few	Few
Approach	Specialized	Availability
Advertising	Psychographic	Sparse
Competitors	Few	Few
PRICING		
Price	Low / Rising	High
Gross Margins	Low	Rising
Cost Reductions	None	None
Incentives	Channel	Channel
PRODUCT		
Configuration	Basic	Stripped
Quality	Spotty	Minimal
Capacity	Over	Over
SUPPLY CHAIN		
Coordination	Low	Minimal

Table 2. Product Life Cycle Characteristics during Decline and Termination Stages

The supply chain mix can be determined by asking certain key questions: What are the customers' service and distribution channel service requirements and what supply chain strategy should be pursued to meet these requirements? Which strategies are feasible for a given company? The right supply chain mix would be designed to achieve the equilibrium between the product portfolio, the life cycles of products within that portfolio and the company's multiple performance objectives. This is further elaborated for consumer electronics, medical devices, food and retail industries in Chapter 3.

1.2 Critique of the Product Life Cycle Concept

Nariman Dhalla and Sonia Yuspeh (Dhalla, Yuspeh, 1976) argued that the PLC concept was overly simplistic as it suggested that each stage followed another in a strict order

with predictable lengths. According to them, these conditions were not always satisfied as some items moved almost directly from introduction to maturity, bypassing the growth stage while others surged to quick peaks of fashion followed by a quick disappearance from the marketplace. More importantly, it is not unusual to see that some products are revitalized after a decline stage through successful promotion, product reengineering and repositioning.

Many product classes have enjoyed and will probably continue to enjoy a long and prosperous maturity stage. Ivory soap, Jack Daniels whiskey, Davidoff cigars are examples for products that have been selling for decades without PLC concerns. In fact, in the absence of technological breakthroughs especially in consumer packaged goods and food industries, many product classes appear to be indifferent to PLC pressures as long as they satisfy consumer needs. One of the most thorough studies to validate the PLC concept for product classes was carried out in 1967 (Polli, Cook, 1967) and found that observations on sales of over one hundred product categories in the food, health and personal-care fields did not follow the expected PLC in most cases. The results strongly suggested that the PLC concept, when used without careful formulation and testing as an explicit model, is more likely to be misleading than useful.

Dhalla and Yuspeh suggests that marketing-communications models which measure quantitatively the influence of different elements on sales, can provide advance warning signals for declining products; The management that uses them will not be misled by minor sales aberrations into believing mistakenly that a brand has entered declining stage.

In his acclaimed book, "*Crossing the Chasm*," Geoffrey A. Moore argues that there is an abyss between two distinct marketplaces for high-tech products – the first, an early market dominated by early adopters and insiders who are quick to appreciate the nature and the benefits of new development, and the second, a mainstream market representing the rest of the consumers, people who want the benefits of the new technology but who don't want to experience all the gory details. He shows that the transition between these two markets is anything but smooth.

Indeed, Moore has brought into focus the reality that at the time when one has achieved great initial success in launching a new technology product, creating early success in sales, one must undertake an immense effort and radical transformation to make the transition to serve the mainstream market. For both buyers and suppliers, continually changing products and services challenge their ability to absorb and make use of the new things, and, fundamentally, companies must refocus away from selling products and toward creating relationships which buffer the shock of change. There is simply too much change in this domain for anyone to tolerate over the long haul.

Much of what Moore brings up in his book are especially true due to dramatic changes in business since 1990s. Rapid advances in technology, increasing deregulation and globalization have changed the environment. To cope with these changes and achieve superior performance, business leaders are adapting new paradigms that allow their companies to work more closely with their traditional and new business partners as well as their competitors. This improved integration is the very essence of the supply chain management. Supply chain leaders are constantly reevaluating their linkages throughout their chain and looking at achieving the business process excellence, while breaking down their functional silos and reorganizing around core logistics-related processes.

One of the main challenges for every management is allocation of resources throughout their firm, assigning priorities to such functions as product development, acquisition and product abandonment while giving full consideration to their company's overall corporate strategy and objectives. One of the ways to deal with this issue is product portfolio analysis and Boston Consulting Group's (BCG) "Market Share/Growth Matrix" is the first such method to be discussed.

1.3 The Market Share/Growth Matrix

BCG's market share/growth matrix suggests that individual businesses can have very different financial characteristics and strategic options depending on how they are placed in terms of growth and relative competitive position. The main assumption here is that

cash flow is a measure of business success, cash use is driven by market growth and cash generation is an indication of the product's market share. Based on these assumptions, the matrix clusters businesses into any one of four broad categories as shown in Figure 2.

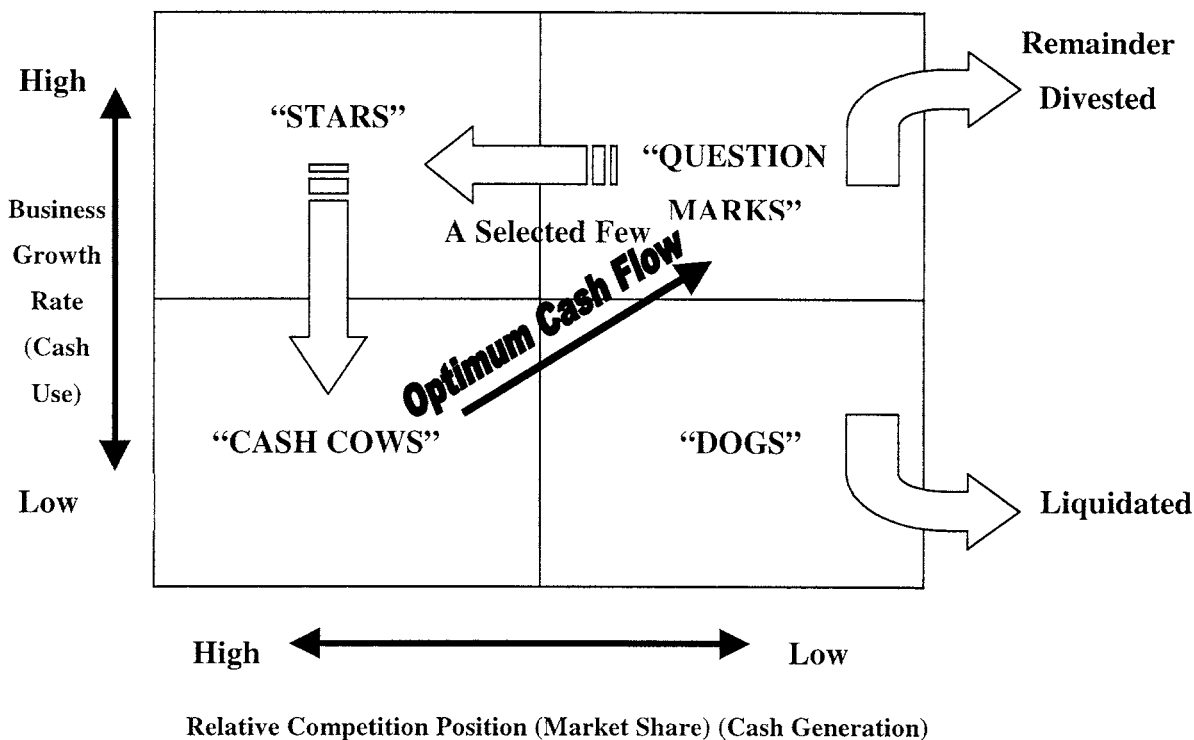


Figure 2. Boston Consulting Group's Market Share/Growth Matrix

Stars (High Growth, High Market Share): Growing rapidly, these products use large amount of cash with added expectations of large cash generation. As a result, these products are often self-financed and can be self-sustained in growth terms. Star products represent the best growth and investment opportunities for companies and special emphasis should be given to maintain and consolidate their market leadership. Sometimes heavy investment beyond the products' revenue generation capacity is needed, and this could reduce the margins significantly for those products. Nevertheless, when the growth slows, large cash generation could be obtained with a maintained market leadership, thus becoming a cash cow. If star products fail to hold their market share, they will ultimately become dogs. This frequently happens as businesses attempt to net large revenues in short term periods by raising prices and not reinvesting, thus creating opportunities for competitors.

Cash Cows (Low Growth, High Market Share): These products have solid market share and low costs: they are the main revenue generating items for companies. Cash cows pay the dividends and interest, provide the debt capacity, pay for the company overhead and provide the cash for investment elsewhere in the company's portfolio of businesses. They are the building blocks of the company.

Dogs (Low Growth, Low Market Share): It is assumed that their poor competitive position result in poor profits. Because the growth is slow, there is less incentive to invest in solutions that will lower product costs and make them more competitive. As the cash requirements exceeds the potential revenue improvements most of the times, these products frequently turn out to be "cash traps", likely to absorb cash unless a major investment is committed. Companies should minimize their exposure to dogs through product abandonment.

Question Marks (High Growth, Low Market Share): These products are the most difficult ones to decide upon. Their cash needs are presumably high because of the market growth, but their cash generation capacity is somewhat limited due to their small market share. For this type of products, there are usually two alternatives: making the necessary investments to gain market share or divesting the product/product group. The first alternative is about funding the business till it achieves market dominance so that it can become a star and ultimately a cash cow when the business matures. Although large amount of cash investment is necessary in short term, over the long run, it is the most viable alternative. On the other hand, if financial backing is unavailable, selling that portion of the business is the one of the alternatives. It is also possible to milk the product till it eventually dies, without making substantial investments.

Most companies have their portfolio of businesses scattered all around the matrix. However, the main goal of the portfolio strategy should be to maintain the position in the *cash cows*, and refraining from substantial investments as the market matures. The cash or profit generated by *cash cows* should be used primarily to maintain the market leadership of *stars*, which are not self-financing most of the time. As the market growth slows down, the goal is to turn them to *cash cows* as well. Any remaining funding should

be channeled to a selective group of *question mark* businesses. The remaining *question marks* should be liquidated or divested like most of the *dogs*.

In reality, since usually there is only a limited number of market leaders and because most markets do mature, most of the products fall into the category of *dogs*. As mentioned earlier, such products are usually at a cost disadvantage and have few opportunities for growth at a reasonable cost. A list of possible actions is as follows (Day, 1977):

- Focusing on a specialized segment of the market that can be dominated, and protected from competitive inroads. This segment is usually characterized with government regulations and other barriers of entry.
- Harvesting, which is conscious cutback of all support costs to some minimum level which will maximize the cash flow over a foreseeable lifetime-which is usually short.
- Divestment, usually involving a sale as a going concern.
- Abandonment or deletion from the product line.

Strategic attempts to use the market share/growth matrix for resource allocation decisions emphasize company's preference for a high growth business and the need to maintain cash balance within the firm. The theoretical or empirical justification for such an inclination or preference is hard to find according to Wensley. (Wensley, 1981)

1.4 The Company Position/Industry Attractiveness Screen

The GE/McKinsey Company Position/Industry Attractiveness Screen is a method for determining a product/product group/business' position in terms of the attractiveness of the industry and its competitive position. Unlike BCG matrix, it is also designed to ensure short-term financial strength while guiding the firm's resources to growth opportunities. The basic technique for this analysis involves identifying the main criteria by which the prospects for a business sector may be judged to be favorable or

unfavorable and those by which a company's position in a sector may be judged to be strong or weak. These criteria are then used to construct separate ratings of "sector prospects" and of "company's competitive capabilities" and the ratings are plotted on a matrix. (Figure 3)

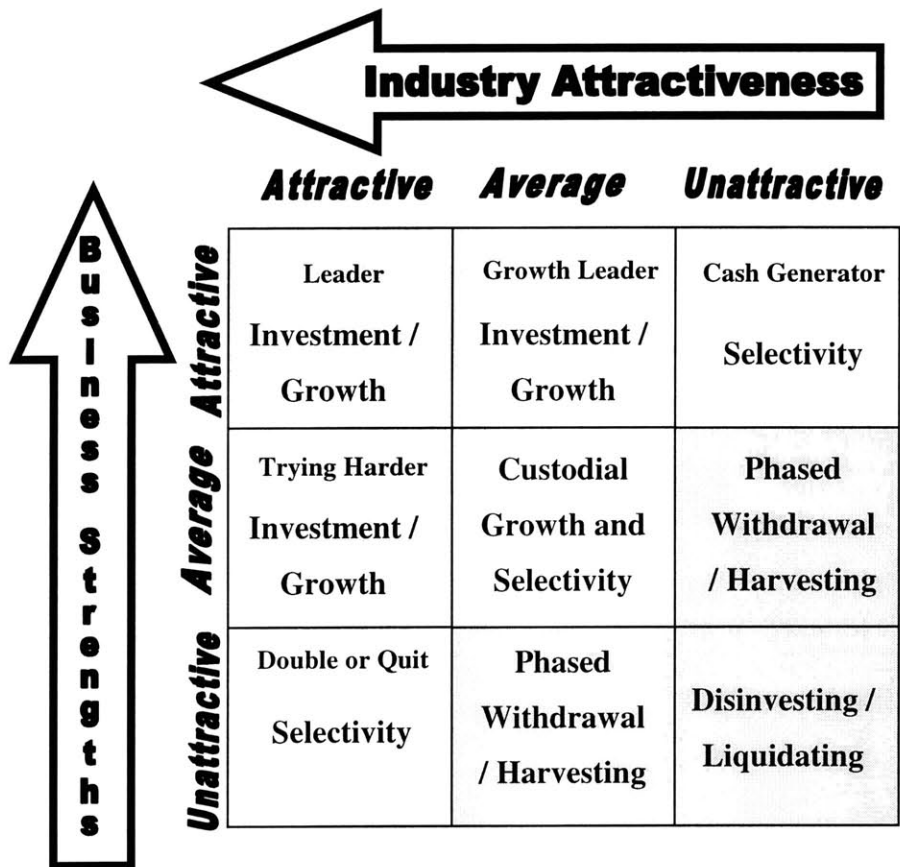


Figure 3. GE/McKinsey Company Position/Industry Attractiveness Matrix

Industry Attractiveness determined by:

- Size
- Market Growth, Pricing
- Market Diversity
- Competitive Structure
- Industry Profitability
- Technical Role
- Social
- Environment
- Legal
- Human

Business Strengths determined by:

- Size
- Growth
- Share
- Position
- Profitability
- Margins
- Technology Position
- Strengths/Weaknesses
- Image
- Pollution
- People

A unit's position on the matrix will determine whether management should invest to build the business, maintain the position by balancing the cash inflows/outflows, or harvest/divest the product/product group/business (Figure 3). If changes are forecasted in industry attractiveness and/or company position, reevaluation of portfolio strategy becomes an issue. Management can use this matrix to determine how corporate resources should be allocated while considering projected cash flows and business development.

As many similar methods using subjective judgments regarding the position of product or business, this method is quite vulnerable to manipulation.

1.5 The PIMS Model

The main objective of the PIMS (Profit Impact of Market Strategy) project was to empirically determine the leading factors determining a particular business' profitability. Performance, operation, financial structure and environment data collected from 200 corporations who were member of Strategic Planning Institute were used to discover most significant empirical factors for business profitability. In return, companies were able to assess the profitability of specific business units/products and develop strategies for those.

Analysis of data concluded that profitability and cash flow of business/product mostly depended on nine strategic factors. These nine factors were able to explain 80% of the variability in profits and they are listed according to their importance:

1. **Investment Intensity:** Technology and the ways of conducting business determine the amount of fixed and working capital required. Generally speaking, investment intensity produces a negative impact on profitability or net cash flow.
2. **Productivity:** Businesses producing more value added per employee are more profitable than those that produce lower value added per employee.
3. **Market Position:** Companies with high market share are more profitable.
4. **Growth of the Served Market:** The served market is the specific segment of the total potential market in which the business actually competes. Growth was seen to be favorable to dollar measure of profit, indifferent to percent measures of profit and negative to all measures of net cash flow.
5. **Quality:** Quality defined by customers' perception and their evaluation relative to competitors' products, has an overall positive effect on all financial performance measures.
6. **Innovation and Differentiation:** If a business has a strong market position, new product introductions and extensive R&D efforts seem to enhance the profitability.
7. **Vertical Integration:** Vertically integrated businesses that operate in mature and stable markets are observed to be more profitable. The opposite is true when those companies operate in growing, declining or otherwise changing markets.
8. **Cost Push:** The rates of increase of wages, salaries, and raw material prices, as well as the presence of labor unions complicates the nature of the profitability in companies.

9. **Current Strategic Effort:** Companies who execute their strategy well are good operators. A good operator can improve the profitability of a strong strategic position.

During the PIMS effort, Strategic Planning Institute has developed a Par ROI and a Par cash flow model to help decision-makers with the evaluation of their business performance and strategic alternatives. These models were essentially linear equations obtained by multivariate regression analysis and they were used to determine the expected level of ROI and cash flow given a company's or business unit's strategic factors under normal circumstances.

Criticism of the PIMS model was mainly targeted towards the specification of Par models and the interpretation of the results. The fact that one large model was used to describe the performance of a wide diversity of businesses seems like an oversimplification. But the most serious problem according to Anderson and Paine (Anderson, Paine 1978) is the implication that relationships in the model are causal. Nevertheless, PIMS project was one of the very few strategy research efforts based on empirical research.

Next, models proposed for management of declining products will be reviewed and a new normative model will be proposed.

2. FRAMEWORKS TO MANAGE DECLINING PRODUCTS

2.1 End-of-Life Cycle Product Selection in Product Portfolio Management

The amount of literature focusing on the management of declining products and product abandonment decision is surprisingly low. In one of the earlier papers, Alexander (Alexander, 1964), lists the following factors as potential candidates to be used in detecting weak products:

- **Sales Trend:** If the trend of a product's sales is downward over time, it deserves examination.
- **Price Trend:** When the price of a product or group of products has been declining steadily while the competitors' prices remain stable over a time, this should deserve attention.
- **Profit Trend:** A decline in profit, measured in overall dollars or margin of sales, should deserve careful analysis.
- **Substitute Products:** When a new product completely or mostly replaces an older product, the older product should be considered for abandonment.
- **Product Effectiveness:** Although this is somewhat more difficult to measure, if a product loses its effectiveness over time, it should be considered more carefully.
- **Executive Time:** Weak products usually demand an excessive amount of executive time as compared to normal products. This is an important constraint usually not considered.

In 1971, Worthing (Worthing, 1971) suggested an annual product evaluation framework described in two phases. In the first phase, products with lower performance levels for the present year than the last year were diagnosed based on the following performance factors: Return on Investment - product profit as a percentage of product production and marketing costs, Profitability and Sales Percentage.

Products identified in the first phase were then evaluated in the second phase in more detail. Management's evaluations of the past, present and future contribution and the potential of the product were collected on three major categories of indicators: financial, marketing and managerial. Scores ranging from poor to excellent were assigned to following indicators, while each scale is weighted according to their importance.

Financial Indicators

- a) Contribution Margin (past three years)
- b) Profitability Trend (past three years)
- c) Sales Volume Trend (past three years)
- d) Price Level Trend (past three years)
- e) Present vs. Potential Use of Funds

Marketing Indicators

- f) Projected Market Growth (next three years)
- g) Market Share Trend (past three years)
- h) Product Line Complemental Factor
- i) Competitive Distinctiveness
- j) Customer Loyalty

Managerial Indicators

- k) Marketing/Sales Personnel Response
- l) Distributor/Dealer Reaction
- m) Machinery/Facility Utilization
- n) Production Personnel Response
- o) Present vs. Potential Use of Manpower

Multiplying the 15 scale scores by the appropriate scale weights and summing them together derived a product's combined score.

Another commonly used diagnostic tool was the product life cycle concept that was described in detail in the previous chapter. Products that were in the declining stage in terms of profitability and sales volume were candidates for deletion, modification or special management attention. Michael (Michael, 1971) argued that, sometimes, eliminating products after their decline stage was not always the optimum solution and we have actually seen examples of that in medical devices industry during the interviews. Michael stated that products that were still in demand by consumers through regular channels, and that caused unexplained competitor sales increases after withdrawal from the market, should not be discontinued as they were entering to the "petrification" stage

of the product life cycle. He argued that high brand loyalty on the part of the remaining customers resulted in possibly higher prices due to the price being inelastic.

Hamelman and Mazze (Hamelman, Mazze, 1972) also presented a model, which was based on the analysis of specific cost/revenue accounting data. Their PRESS (Product Review and Evaluation Subsystem) model was intended to periodically review all the firm's products to identify those that were no longer earning revenue in proportion to the efforts and required resources. A variable cost accounting approach including standard costing, unit price and volume was used in determining weak products. Fixed costs and other allocated expenses were not considered, thus, favoring "products with high contribution margins regardless of their disproportionate resource usage."

It is also important to note that product profitability measures are only as meaningful as the identification and allocation of costs associated with generating the revenue from the product in scrutiny. Many of the profitability indicators prior to 1980s suffered from the inadequacies of allocating costs arbitrarily. The activity based costing systems that are in place in many of today's companies offer better profitability analysis for companies, often within the context of an ERP system. Worthing (Worthing, 1975) proposed that this type of activity based costing systems should be extended into the area of marketing. He states that marketing expenses should be allocated to products on the basis of measurable factors that bear a causative relationship to the total amounts of the functional cost groups. The basis for the allocation could be either direct or proportional to a cost driver.

Kotler, in his 1978 article (Kotler, 1978) argued that product harvesting was a good way of managing weak products and getting revenue through reduction of the investment in a business entity in the hopes of cutting costs and/or improving cash flow. He recommended the following seven indicators for identifying the candidates for harvesting:

- The product is in a stable or declining market.

- The product has a small market share and increasing it would be too costly; or it has a respectable market share, which is too costly to defend or maintain.
- The product is not producing satisfactory profits.
- Sales would not decline too rapidly as a result of reduced investments. (This could be due to brand loyalty)
- The company has better use for possibly reallocated funds.
- The product is not a major or strategic component of company's product portfolio.
- The product does not contribute other desired features such as sales stability or prestige.

Many of these criteria are driven by marketing and are focused more towards product portfolio management. They all seem to ignore supply chain issues and costs that currently stand at more and more strategic levels and define the competitive advantage for today's Fortune 500 companies.

2.2 Supply Chain Management

In the 1970s, supply chain management, which was focused mostly on distribution, was emphasizing the integration of warehousing and transportation operations within companies. The main driver was an all out effort to reduce the cost of holding inventory in a business environment where the interest rates were in double digit. Companies had to focus on the efficient usage of capital and how to make internal changes to reduce the warehousing and distribution costs.

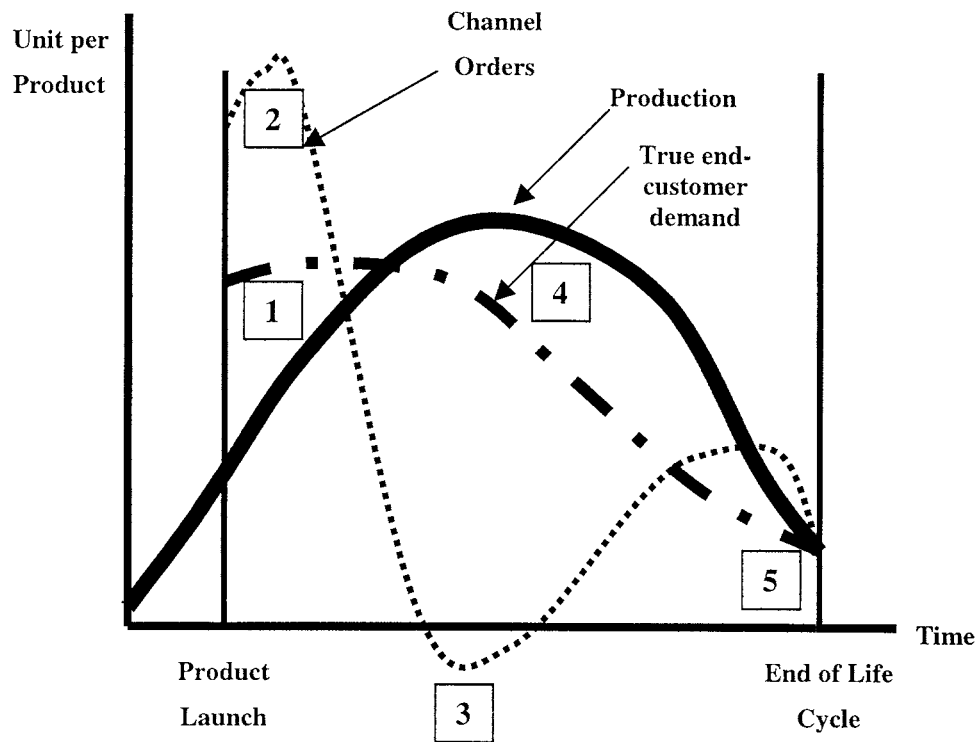
During 1980s, the focus of supply chain management shifted to restructuring and reengineering of supply chain functions. Lowering supply chain costs and reducing the assets was the primary focus while supply chain processes were integrated to companies'

operations. Major reductions in transportation, order entry, customer service, administration and inventory costs were achieved throughout the decade.

Growth which was long considered the responsibility of product development, sales and marketing in many firms, emerged as an objective of supply chain organization as well during the 90s. The focus of supply chain management shifted from reducing cost to improving customer service. Companies with higher supply chain performance started realizing revenue growth and higher profitability through greater market share and higher premiums compared to their competitors. Due to the increasing focus on customer service and growth, companies are revisiting their channel structure while more innovative players are entering to new arrangements with channel participants in order to reduce costs and broaden the customer reach. The common view today is that the supply chain management can both enable and drive the business strategy, product management of many firms, thus it is difficult to look at the slow moving products in an isolated matter.

Today, one of the most compelling cases for creation of value through supply chain integration is happening in the PC industry. Supply chain inefficiencies in that industry have delayed new products, created demand distortions, scarcity and allocation problems, inventory obsolescence risks and very low service levels. A study conducted by Andersen Consulting in partnership with Stanford University and Northwestern University (Austin, 1998) found that consumers were increasingly demanding products with unique configurations, resulting in proliferating product offerings and increasing number of SKUs. As competitors were becoming increasingly adaptive despite this costly differentiation, there has been a rapid decline in average selling prices and profit margins due to stiff competition.

The success of PC manufacturers was revolving around achieving the alignment of supply and demand, leaving little room for error in getting products to market. If products were not available at the introduction phase, there would be a negative impact on market share almost immediately. The figure 4 represents the misalignment of demand and supply throughout PC's product life cycle.



- 1- At the introduction or shortly after, production can not meet initial projected demand, resulting in shortages.
- 2- Many times, distributors and resellers often over-order as a way of hedging against continuing shortages, creating the so-called “phantom demand”.
- 3- As supply catches up with demand, orders are canceled or returned
- 4- Due to misalignments in financial and production planning, production still continues while the inventories keep piling up.
- 5- As demand goes down, all parties try to get rid off excess inventory with write-offs and liquidations.

Figure 4. Misalignment of Demand and Supply during PC Product Life Cycle

In fact, many examples of this “Forrester flywheel effect” (Forrester, 1968) can be seen in a variety of industries in which every player is overordering against uncertainties in both the marketplace and supply chain. Specifically in the PC industry, the study showed that the level of integration between upstream suppliers and downstream customers was quite low. In order to properly assess the value of integration activities, the research team

developed an economic model using performance indicators such as inventory turns and gross margins. The value-creation model and industry benchmarks recommended three strategies to achieve the integration:

- **Pursue compression strategy:** Complex chain structures usually create higher amount of finished goods inventory being tied up in various places in the chain. Subsequently, customers orders can not be filled and product become obsolete. Direct model and inter/intra postponement operations are the main enablers for achieving channel compression, thus reducing finished goods inventory levels.
- **Implement collaborative planning with supply chain partners:** One of the key enablers to achieve lean inventories whether they are slow or fast moving and increased market agility is the collaboration in planning and executing amongst supply chain partners. Rapid technological changes resulted in ever-shorter product life cycles, thus complicating supply and demand alignment. The key activities include collaborative demand planning, synchronized order fulfillment and joint capacity planning.
- **Design products for maximum market responsiveness:** Seeking to achieve the best balance between product innovation/performance, optimal supply chain efficiency/agility is the key to design for responsiveness. It is important to assess just how the supply chain will perform for the new product and whether off-the-shelf and inter-generational parts (which are not obsolete through product life cycles) can be used in between new product introduction.

2.3 Product Life Cycle and Supply Chain

Inadequately considered supply chains can have a profound impact on customer satisfaction and the financial strength of corporations. As discussed earlier, a history of inadequate inventory of finished goods and inability to meet customer demand can

destroy a company's reputation and create customer retention and loyalty problems. It has been estimated that getting new customers is a ten-fold more costly operation than retaining the existing customer base. On the other hand, excessive inventory is a burden on financial resources and in today's fast-paced technological changes, there is a good chance that too much "old-product" often ends up being written off or liquidated for cents on the dollar. When logistics strategy is integrated properly with overall business strategy, then the right inventory level, its positioning, channel partners and service strategies could be determined.

Another important challenge in a consumer environment is how to manage the product life cycle. Especially, the rapid deployment of advanced communications, information and computing technologies resulted in shortening of product life cycles and increased likelihood of owning obsolete inventory in larger amounts. Charles Fine (Fine, 1998) described industry clockspeed as the rate of change of the industry's evolution, particularly, rate of change of the industry's products, processes and organizations. He cited the microprocessor industry as an example of fast clockspeed and aircraft manufacturing as a slow one: microprocessor industry constantly evolves and products become obsolete in two years or less.

The longer a product spends in the distribution channel, the greater the risk of inventory obsolescence. In an industry with fast clockspeed, this risk of obsolescence is greater. In the PC industry, still, many manufacturers sell their products through distributors and retailers. When the new chip arrives, retailers either sell the old PCs at a discounted price or send them back to manufacturers. As we are all familiar, Dell's solution was to sell direct to customers to avoid excess or obsolete inventory. It could be possible to generalize this type of direct selling method to other products with faster clockspeed such as clothes, toys, software, etc. and particularly the e-commerce channel is well suited for it. Movies and music downloadable through Internet are the latest examples for products where clockspeed is even shorter.

It is important to note the difference between clockspeed and product life cycle. While clockspeed depends mostly on the innovations of the product, as discussed earlier,

product life cycle is more dependent on the market where consistent product innovation can increase product life cycle. Shorter life cycles require a different approach to demand planning relative to long life cycle products. Moreover, product life cycle itself must be planned and managed with well-defined launch, migration and exit strategies. Obsolete inventories could become disastrous from a financial point of view, especially for industries with fast clockspeed and high product cost, such as telecommunications and networking equipment manufacturers. When a supply chain strategy is especially linked and tailored to the stages of new product introduction, growth, maturity and decline, the best supply chain mix will be achieved to deliver different business objectives at each stage of the cycle.

The supply chain mix can be determined by finding answers to some key questions:

- What are the customers' service and distribution channel service requirements?
- What supply chain strategy should be pursued to meet these requirements?
- Which strategies are feasible for a given company?

Multi-layered and multi-sourced demand based planning is one of the key enablers to solve this puzzle. Point of sale data should be used to do better forecasting and reduce inventory risk. Also, the cost-service trade-off would change depending on the stage of the product's life cycle. The right supply chain mix would be designed to achieve the right balance between the product's life cycle and company's multiple performance objectives.

As products reach their end-of-life cycle, up-front customer and decision support becomes less important, margins begin to shrink, and the Internet offers an appealing sales channel. The Internet offers a great opportunity for manufacturers to sell products that are nearing their end of life cycle and becoming obsolete. Lands' End Inc., a major clothing company, closed three of its 19 outlet stores in March 1999 according to ComputerWorld magazine (Machlis, Vijayan, 1999) - partly because the Internet is a better way to sell off surplus inventory, the company announced as part of an overall restructuring effort. The move points to the growing importance of the Internet as a

channel for disposing of overstock and end-of-season inventory, analysts said.

According to the article, Lands' End finds both catalogs and the Internet to be more cost-effective in liquidating overstocks without further elaboration.

Recently, The National Association of Wholesaler-Distributors (NAW) has entered into a strategic alliance with TradeOut.com to provide wholesaler-distributors with an effective way to dispose of excess inventory and idle business assets using the Internet.

TradeOut.com is a leading online marketplace for business-to-business excess and obsolete inventory across a variety of product categories, including computers, consumer automotive, hardware, capital equipment, and others. NAW has exclusively endorsed TradeOut.com as its preferred Internet exchange for excess inventory and idle assets in the wholesale distribution industry.

In some industries, agreements amongst wide-ranging manufacturers and suppliers on product design standards are starting to become common news. These types of agreements have profound effects on extending product life cycle through recycling or cannibalizing a product (Figure 5). In October 1999, the industry's top notebook PC and flat panel display (FPD) manufacturers announced a mechanical and electrical standard for current and future notebook PC displays (VESA, 1999). It is predicted that this new standard should help improve notebook PC display availability and allow each manufacturer to reduce their time to market, allowing them to spend more time on reliability, service, support and price. The standard should reduce the overabundance of custom display module designs that has forced notebook OEMs to modify their packaging, interface design and tooling nearly every time a new panel supplier or display module is adopted. It will lessen the development cycles and logistics problems created by product obsolescence. For the flat panel display industry, the standard offers the potential to decrease the number of designs and part numbers, improve the utilization of engineering resources, and reduce inventory control and other obstacles to design wins.

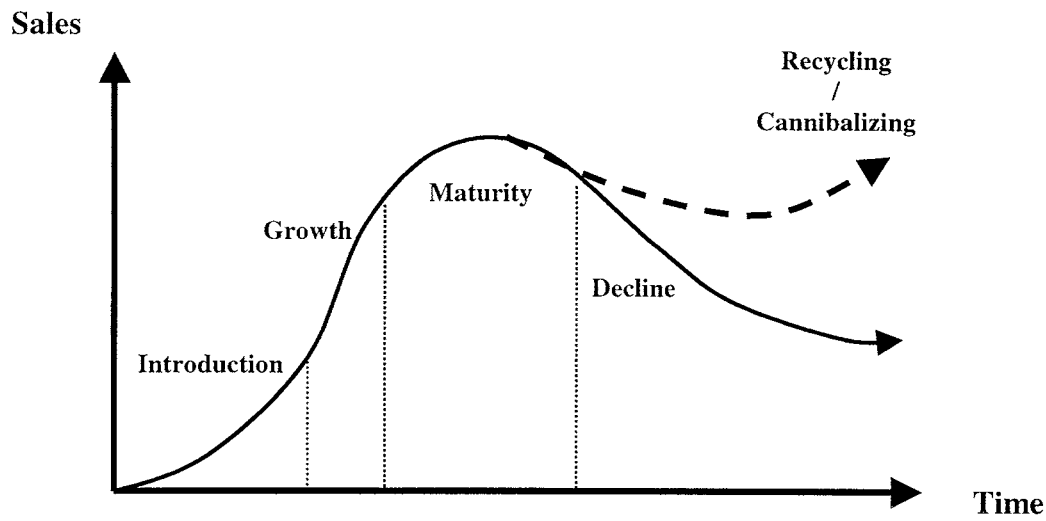


Figure 5. Extending Product Life Cycle

2.4 A New Paradigm: Spontaneous Built-to-Order

It is a well-known fact that companies such as Dell Computers have built their reputations on rapid response, build-to-order manufacturing. But, the Dell model is a relatively crude precursor to the high-octane supply chains that are taking shape now. These operators, particularly dot-com companies in business-to-business markets, will not need conventional, inventory-bound supply-chain management, according to Dr. David M. Anderson, a management consultant (Cotrill, 2000).

Making parts in batches to feed inventories and supplying customers in job lots from these inventories are processes hopelessly out of synch with the way in which e-commerce is evolving. Moreover, demand forecasting is becoming "an exercise in futility," said Anderson, further undermining the traditional, batch-oriented way in which products are manufactured and delivered. The new paradigm is producing in batch size of one.

Many of the dot-com companies that are opting to use warehouse-based fulfillment services are not on the right track. The right direction is developing a supply chain that

can meet the next-day expectations of e-commerce customers. A general recommendation to blossoming dot-com enterprises is to look for manufacturers who can make products on demand rather than getting into warehouses and paying for inventory. There are relatively few manufacturers that fit this profile at present, but Anderson believes the number will grow rapidly as the e-commerce market matures. Companies such as Dell have helped to lead this effort but in reality, Dell is not really doing spontaneous build-to-order, but assembling to order: the high volume of orders Dell processes enables it to support warehousing operations close to assembly lines, creating the illusion that it is building product as orders come in. (Trommer, 1998)

The reality of spontaneous build-to-order is a supply chain where the inflow of raw materials and parts matches the outflow of finished products. Ordering, manufacturing and delivery are part of the same continuum so that a customer's order is turned into a delivery in a single, uninterrupted cycle. This is achieved without demand forecasts, goods inventories or procurement processes based on purchase orders.

The companies that will be first are those already vertically integrated enough to do it. For example, Whirlpool, the maker of household appliances, is a good candidate since parts such as motors and electronic components are usually highly standardized and can be manufactured on demand and supplied in synchrony with the inflow of orders for finished machines (www.whirlpoolcorp.com).

In order to achieve this continuous flow, supply chains must be simplified by following initiatives:

- **Materials and Parts Standardization:** Materials and parts need to be standardized as far as possible to reduce the number of variations that the supply chain has to accommodate. The more you standardize on parts, the easier it is to speed up the supply chain. For example, Intel's Systems Group reduced the number of its active part numbers from 20,000 to 500 by introducing more standardization into product design. Standardization on raw materials also helps the control of supply chain.

- **Automatic Resupply:** Also smoothing out the supply chain is automatic resupply, where parts and materials are replenished automatically without the need for purchase orders. Using this Kanban method can automatically activate a physical signal, such as a tag, when fresh supplies are needed. Minimum stock reorder points and physical bins, which are appropriate for small, low-cost items, can be refilled as soon the reorder point is reached or bins are empty.

Supplying customers requires what Anderson refers to as a "spontaneous supply chain." Instead of drawing parts from inventory to fill an order from a customer, the manufacturer reacts instantly to "pull" signals from the customer and makes the parts to order. Again there are a number of ways to do this. The automatic resupply methods described above can be applied to order fulfillment, for example. As supply chains become more spontaneous, it is anticipated that a boom in express distribution will happen to meet the highly demanding schedules of quick-response, build-to-order operations. Many of the trucking operations will also be moving to spot market rather than long term contracts.

In spontaneous build to order system, the velocity in the supply chain and the unnecessary forecasting accuracy will reduce the risk of finished goods obsolescence and work-in-process inventories will be at minimum levels. This is particularly important in terms of being able to respond to real customer demand without lost sales when a product is launched. In high-tech industries where product life cycle is as low as six months, this is a crucial alignment that must be achieved without building up risky inventories. Nevertheless, certain industries will still have big economies of scale built-in throughout their supply chain like in chemicals and it is very unlikely they will be embracing this concept.

In the next chapter, findings through the interviews and surveys of companies from networking equipment, medical devices, retail, food and consumer electronics industries will be discussed in detail together with their supply chain efforts.

3. INDUSTRY PRACTICES ON MANAGEMENT OF END-OF-LIFE CYCLE PRODUCTS

During this study in-depth interviews and surveys have been used to find the management processes applied to declining products across a wide range of industries. Findings from eight multi-billion dollar corporations are summarized in this chapter grouped by the industry they operate in.

3.1 Networking/Telecommunications Equipment Industry

Company A:

With over 300 million customer connections worldwide, Company A connects people and organizations to information and each other in innovative, simple and reliable ways, more than any other networking company. They deliver e-Networking solutions through information access products and network systems to enterprises, small businesses, and consumers, carriers and network service providers. This company leads the industry in Ethernet, Fast Ethernet, and Gigabit Ethernet connectivity, specifically NICs, switches, and hubs. They also occupy a strong position in stackable systems, enterprise switching, voice-over-IP (Internet Protocol), and virtual private networks. Additionally, Company A offers leading-edge solutions for implementing wireless access, ERP systems, distributed training/distributed learning, call centers, and digital asset management.

- **Business/Product portfolio analysis:**

Last year, the company began a systematic analysis of its business portfolio along two dimensions: growth and return on invested capital or ROIC. They found that their portfolio was quite heterogeneous as it ranged from hypergrowth businesses to good growth, mature businesses. However, despite several efforts, analog modems only improved marginally, and its large enterprise LAN and WAN core businesses simply did not improve. This analysis helped them reach a first set of decisions: to transition and stop all non-strategic activities on these identified businesses. In all cases, the company approached these transitions on three principles:

- Minimizing the disruptions imposed on customers, partners and employees.
- Preserving all the technological assets the company might need in future product developments.
- Making sure they could execute these transitions rapidly. For them, rapidly means 90 days or less.
- **Distribution channels and declining products:**

Company A primarily uses a two-tier distribution network. It sells through a wide range of distributors, as well as directly through Internet (Figure 6). End-of-life cycle products are specifically listed on Company’s web site 60 days in advance before the product is discontinued.

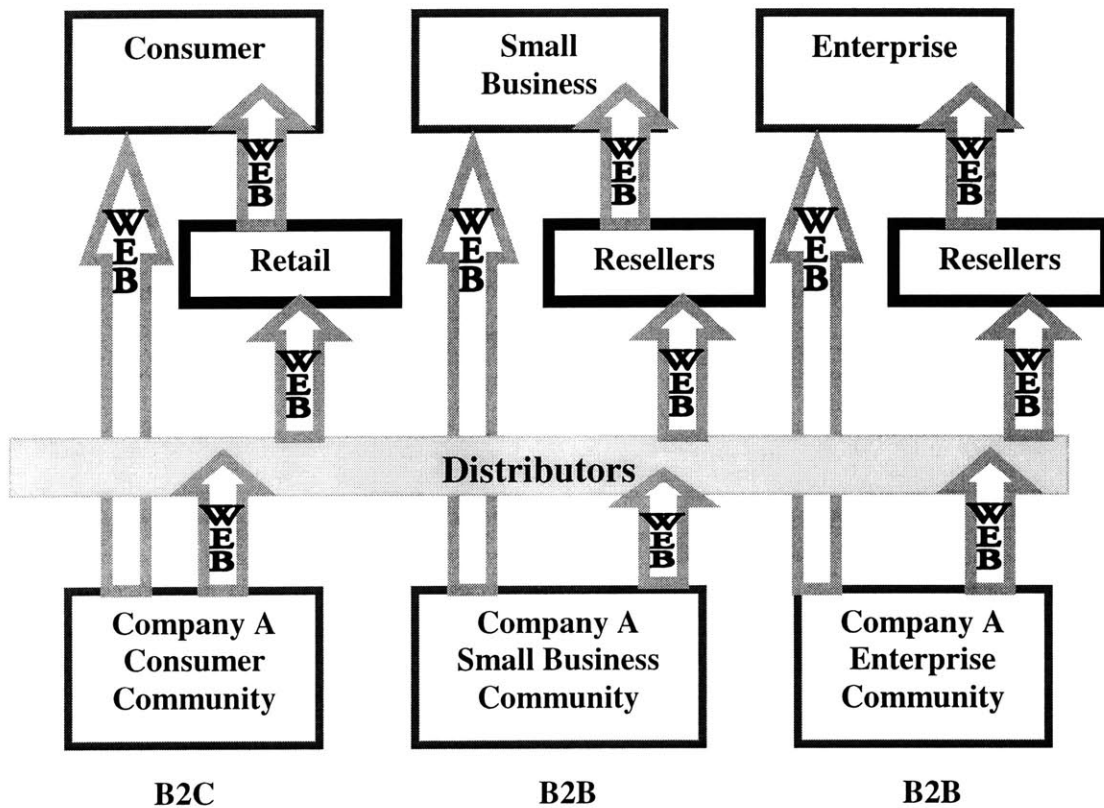


Figure 6. Web Enabled Distribution Channels of Company A.

A combination of rapid change in technology, planned obsolescence and problems in managing product life cycle where new technology is cannibalizing the old

technology are the main reasons for slow moving inventory in Company A. As the company relies on two-tier channel distribution model, product buffers are built up across entire supply chain and product reaching end-of-life cycle can get caught up in those buffers in the form of safety stock. Inability to monitor sales out and inventory levels on some products creates obsolescence. Company A confirms that all of their products fit to the product life cycle scheme.

- **Organization and decision makers:**

The supply chain organization in Company A owns inventory completely from procurement all the way to disposal. They do not have separate ownership of inventory by a business unit, the ownership is centralized. The supply chain organization is made up of procurement, manufacturing and distribution and directly reports to president. As a result of this advanced supply chain view, operational efficiency is achieved; inventory turn went from 4.4 to 9.8 –a figure above the industry average- over 1.5 years, net inventory was reduced by more than half and inventory levels maintained on hand in the channel are reduced from 6-8 weeks to 4-5 weeks.

According to a senior executive, this success was achieved by better business planning: aligning the business unit revenue plan with marketing forecast and manufacturing bill plan, as well as better communication across the supply chain. Yet, the most significant change in their business model was moving to build-to-order and intra/inter company postponement.

Product abandonment decisions are made when next generation product is being substituted, cannibalized or replaced. Supply chain executives and product managers are the main decision-makers.

Obsolete and declining products are liquidated through brokers, discounts and firesales. In addition to company's own direct sales through the Internet, distributors also sell through the web through auctions and firesales. End-of-life cycle product is not brought back to the Company until the very end. Finally, the unsold products are

consolidated at a centralized location where the “long tail” of a particular product is managed for spare parts and service requirements.

- **Software support system:**

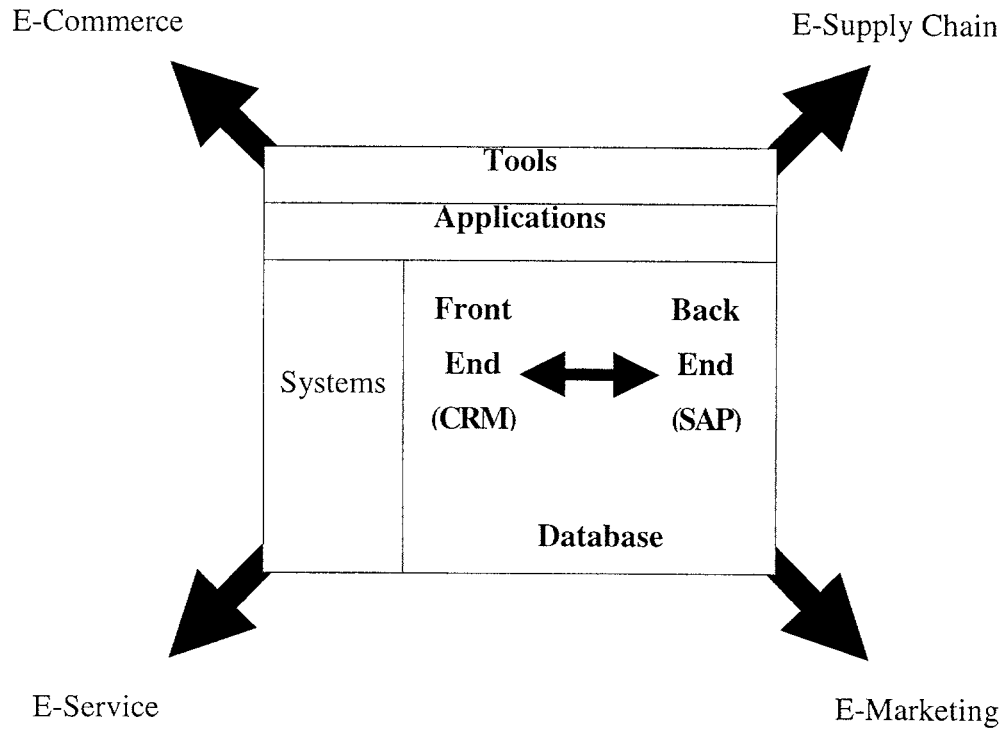


Figure 7. Web-enabling Company A (Adapted from their Web Site)

Company A intends to be a leader in the use of Web based technologies to drive all key operations in the company. (Figure 7)

E-Marketing will allow them to do on line need analysis. Product Wizards will help customers select the right products and solutions to meet their needs, and they will make extensive use of database marketing to build one to one relationships with their customers using extensive CRM software.

E-Supply Chain initiative allows customers to order, obtain credit approval, confirm availability and correctness of configuration, and track of backlog until receipt at the customer. In fact, they already have this capability operational, using Ingram as a fulfillment partner.

E-services initiatives already allows customers to diagnose and self repair simple operational problems and is a way to quickly determine when specialized assistance or dispatching of a technician is required.

To support their E-business plans, Company A has built a world class infrastructure, which includes well-integrated tools and applications into a highly available and secure environment. All of their front-end systems are completely linked to SAP and are supported by a common data warehouse environment.

Company A has an ERP system (SAP) in place completely managing every activity in the supply chain. Its inventory management system is able to delineate between the products that are active and discontinued. They are able to age the inventory and segregate it to know exactly how long it has been in the channel and at what stage of product life cycle it is. There is a dedicated system in place identifying the end-of-life inventory based on sales activity and inventory position data provided by distributors, value-added resellers, ISPs and integrators. On the other hand, company is currently struggling with the implementation of an Available-to-Promise (ATP) module. Definition of rigid business rules and maintenance of many supporting tables are the main issues. At this point, it is not clear whether they will be implementing other decision support systems such as SAP's Product Life Cycle Management modules.

- **Suppliers:**

One of Company A's main suppliers is Lucent. Their microelectronics group invested more than \$100 million in an Oracle enterprise resource planning system, which gives employees a global view of its supply chain within three minutes of any transaction. Every time a product moves from one workstation to the next, it is logged into the system. Such up-to-the-minute details help Lucent identify when products will be able to be shipped.

Company A want Lucent to deliver chips it needs within 48 hours of an order. When an electronic data interchange purchase order enters Lucent's Oracle system gateway, the system verifies customer data and checks to see if the product is available. If it is, the

system triggers a module in the ERP system that instructs the factories in Bangkok, Singapore, or Pennsylvania to pick and pack the chips and hand them over to DHL. Simultaneously, the system sends an EDI confirmation to Company A. The connection is expected to migrate to the Internet by next year.

- **Performance metrics:**

Company A uses 6 performance metrics within the supply chain organization effecting the management of declining products:

1. Order Cycle Time (Availability): time it takes for the order till it is delivered.
2. Percent On-Time: predictability of on-time performance against promised orders.
3. Supply Chain Cost: as a percentage of revenue.
4. Inventory Turns
5. Cash to Cash Cycle
6. Accounts Receivable

A Supply Chain Equilibrium model is in place to make cost vs. service tradeoff decisions.

- **Further improvements:**

Supply Chain Operations in Company A are clearly on track for shrinking the supply chain down, reducing inventories and write-offs. Now that the company has built a world class ERP system, they are working on linking up with their suppliers directly and have automated replenishment based on actual customer orders and inventory levels, moving towards the “spontaneous built-to-order” system that was mentioned in the previous chapter. While breaking down the walls that separate their business from their customers, suppliers and partners, they intend to take a lot of cost and complexity out of the system, reducing amount of obsolete inventory on finished goods, parts and materials.

3.2 Medical Devices Industry

Company B:

Company B is a big international medical device company dedicated to minimally invasive therapy, and employs approximately 13,500 people worldwide. The Company's products include more than 10,000 catalog items in over 50 categories, and are defined as vascular or non-vascular depending on the system and procedure in which a product is intended to be used.

- **Product characteristics:**

From an expiration perspective, all products have a 2-3 years shelf life, primarily due to their sterility conditions. Once produced, they are put on the inventory system on a FIFO basis, while tracking the date it was produced and the standard expiration date. From the product life cycle standpoint it is harder to determine where an item actually stands. Typically it is the market that decides the replacement of the product.

Typically, it is very difficult to liquidate end-of-life cycle product. It used to be that US medical companies were able to move slow moving products to emerging markets; however, as Company B's products do not require as much capital expenditure in the operating room, customers require that the latest technology be available to them. It is also a politically incorrect way of running the business for those markets. Occasionally, products close to expiration are donated.

- **Supply chain:**

In late 1998, Company B initiated a supply chain optimization program targeting reduction in inventory levels and related write-offs, seeking improvement in service levels, fill rates and product cycle times.

The company is currently pursuing the implementation of a hybrid replenishment model, which couples the production to actual sales. The inventory levels at global Tier 1 distribution centers are set using analytical models such as EOQ and replenishment signals based on actual inventory levels vs. target levels trigger shipment and production at various plants. Global safety stocks are pooled in these locations. Orders based on recent consumption at Tier 2 DCs are sent to global distribution centers for quick replenishment.

One of the key improvement areas is in product transition management where the following programs were identified to have high positive impact:

1. Improving forecasting accuracy using probabilistic scenarios.
2. Reducing pre-launch forecast bias by updating with available market data.
3. Selecting optimal inventory coverage based on probabilistic sales forecast using “Newsboy Model.” (Johnson, Montgomery, 1974)
4. Coordinating launches globally, optimizing local coverage allocations and margins.

Figure 8 shows that the new product transition solution is designed to address the three sources of inventory excess:

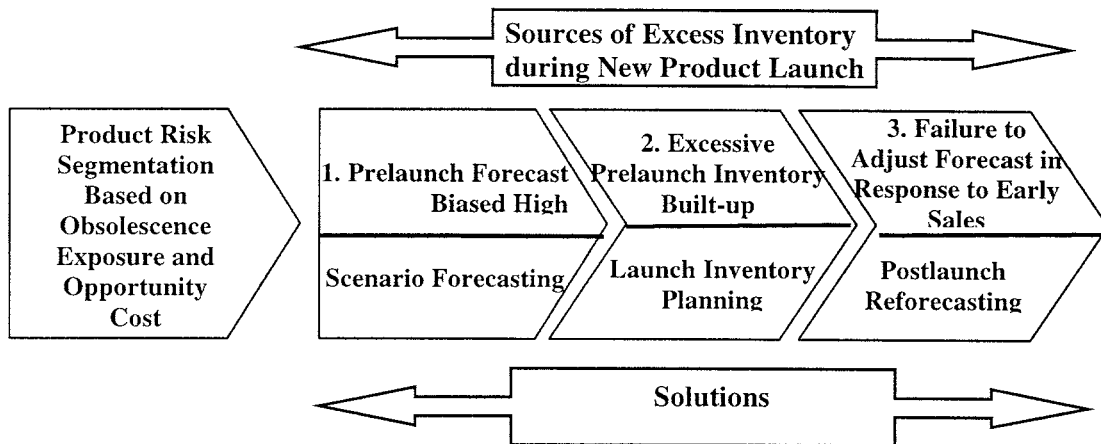


Figure 8. New Product Launch Initiatives Dealing with Chronic Excess Inventory

- **Organization and decision makers:**

The new initiatives launched by the company required that inventory deployment and allocation should be managed globally by supply chain organization. Product managers initially had almost the sole input on the decision of product transition and abandonment and the tendency was “don’t take anything out of the market”. Company B was well aware of the supply chain price paid, and they have been able to show why these were unfavorable decisions. Now, the product managers are still responsible for getting products through the development cycle with product development team members, but, planning the product launch is done together with a new group of professionals called

“Global Supply Chain Managers”. These individuals have the ownership of discontinuation, reduction and production decisions rather than product managers.

Usually product managers identify those products that are cannibalized and communicate them to global supply chain managers. Customer conversion rates and utilization rate of new versus old products drive down the probabilistic forecasting process. Unless the substitute product is superior, the replaced product is allowed to reach an equilibrium level. When the demand for the cannibalized product becomes too low, the product abandonment decision is made and communicated to customers that have recently used the product. These types of end-of-life cycle product are brought back to top echelons and the replenishment targets in lower echelons are adjusted to avoid excess and obsolete inventory for the declining products.

- **Software support system:**

Company B replaced twenty-one different systems with a global ERP implementation. Now that they are on a common platform, they will be looking at more advanced planning systems. One of these systems is SAP’s advanced planner and optimizer and their product life cycle management suite.

Redeployment of end-of-life cycle products from lower echelons to global distribution centers is still a manual process. Every month a deployment model is run to find out whether any product will be moved and these decisions are made for worldwide operations. Every quarter a set of reports is generated to analyze the level of excess, expired and obsolete (EE&O) inventory using mostly queries run against ERP databases.

- **Performance metrics:**

In Company B, supply chain and manufacturing organizations have their own balanced scorecards which reflects efficiency and performance on supply chain management, market planning, supply chain execution, distribution and manufacturing. Specifically, supply chain outcomes are judged by finished goods inventory turns, the amount of EE&O, customer service levels and backorders. Marketing product managers are measured on their forecasting accuracy for new, mature and declining products.

There are two other categories of inventory that marketing has an impact on: one of them is consignment and the other one is “trunk-stock”, inventory held by sales people to help small customers/hospitals. Marketing drives inventory decisions in these categories and there is a set of performance metrics around them.

- **Further Improvements:**

Company B recognizes that they need to gain the ability to make quick and tough decisions on end-of-life cycle products. They are having difficulties in moving customers from older generation products to newer ones; sometimes marketing will overstate the customer preference and take the easy path. Although it is improving, supply chain perspective and costs need to be further included in marketing decision making.

3.3 Consumer Electronics Industry

Company C:

Company C is the United States subsidiary of a large consumer electronics company headquartered in Japan. The Company is a leading manufacturer of audio, video, communications and information technology products for the consumer and professional markets. Its music, motion pictures, television production, computer entertainment operations and online businesses makes the company one of the most comprehensive entertainment companies in the world.

Over 28,000 employees are employed in 14 plants across North America producing multi-billion dollar revenue with the support of 5 major R&D and engineering facilities. Company operates four regional distribution centers across the United States.

- **Product characteristics:**

Company C has one of the most recognized brands in consumer electronics industry. The general focus is on brand management and product innovation and proliferation. On the

other hand, new technologies in consumer electronics reduce the product life cycle to less than two years in some of their product groups. It is mainly product sales that determine slow-moving inventory. End-of-life cycle products are usually liquidated through the company's own outlet stores and family stores serving the employees. Occasionally liquidators are used to sell the excess and obsolete inventory.

By law, company C must support its products for five years, and often times a part of the slow moving inventory is kept for parts and replacements. It is not known how this inventory level is determined.

- **Supply chain:**

Company C sells most of its products through retail stores. A group of its products are also available through online direct sales, most of them being specialty items. However, the Internet is mainly used for product information purposes. A logistics division is responsible for the distribution activities. A new initiative is currently in place to move end-of-life cycle products to third party warehousing mostly due to capacity constraints.

A supply chain organization is not foreseen any time soon at this point.

- **Organization and decision makers:**

A marketing group in Company C owns the product and determines their fate unlike the previous examples analyzed. The logistics division prepares a report on slow moving products for marketing every quarter, as they are not aware that the company holds this type of inventory; their main focus is fast-moving products, what they are selling today.

More cooperation has been seen between marketing and distribution as one of their main initiatives is focused on dealing with obsolete inventory and improving inventory turns.

- **Software system support:**

Company C relies on mainframe reports to track how frequently products are moving in the warehouses. Generally, the inventory of slow moving products is reviewed quarterly and at the year-end. The existing warehouse management system is not used for any type

Company D reduced the number of models in two of their main lines by a combined fifty percent and established mandatory profit margin requirements. They closed down an unproductive factory and brought discipline and profitability to North American operations. This year, they came to market with an attractive catalogue of products and with marketing and pricing strategies that should prove profitable. That is very important to Company D, because the strength of their brands and the consumer's enthusiasm for them drives their success in the automotive and computer OEM fields.

Company D has a strong brand reputation. The life cycle of Company D's products varies from one to two years. They are mostly subject to planned obsolescence, which is a function of speed of new product development. Products are categorized by brand, market and price premium. Lead times in manufacturing and product design make product obsolescence a guessing game and eventually leads to write-down costs. Unexpected obsolescence is another problem, which increases obsolete inventories due to rapid changes in technology.

- **Supply chain:**

A number of their competitors are placing dedicated stores in upscale malls to sell their products in exclusive settings. They feel that established distribution and conventional product displays do not serve them adequately. Company D has seen the value in direct selling through the outlet stores they own and operate in California and Arizona. Direct selling through advertising in magazines, direct mail and the Internet have also proved rewarding for a number of firms in the consumer field. For those without a meaningful position in traditional markets, the Internet represents pure upside opportunity. For those with established brands and distribution, a headlong rush to retailing on the Internet can be dangerous and disruptive. Company D is using the Internet to extend their brand reaches while paying careful attention to their existing distribution relationships.

More than three hundred other websites offer the company's products. Of that total, Company D authorizes and recommends nine, which satisfy their stringent requirements. Amazon.com's new electronics store now markets Company D products as their primary component electronics and loudspeaker brands.

In July 1999, Company D launched a suite of Internet commerce solutions including the industry's first dealer Extranet. This innovation will allow dealers, large and small, to conduct business with them electronically. Many dealers will pay for the products with credit cards. The benefits in operating efficiency, customer service and overhead reduction will be substantial.

Company D also uses alternative channels such as auction sites to liquidate their declining products, as well as their website.

- **Organization and decision makers:**

Company D distinguishes itself with superior customer service, in-stock availability and correct order processing. The company's logistic organization is still at divisional level and is not centralized, very much like Company C.

Product responsibility is on the shoulders of brand senior executives, and they directly report to the president of the company. Every month, the company conducts a review of declining products, which is more frequent than in the previous companies analyzed. Company D believes that one of their strengths is this planned process of review and clearance of obsolete products on a regimented schedule. Once those products are identified, price reduction, increased promotion and inventory adjustments are made. Company D also considers alternative channels for end-of-life products.

Product shortage costs are reevaluated and new inventory levels are established for declining products. During the product abandonment process, the company considers alternative usage of released assets and potential liquidation/salvage revenue. Once the products to be abandoned are identified, they inform their suppliers and channel partners three months in advance. For those type of products a combination of harvesting and slow retirement strategies are employed. Occasionally though, the product is dropped immediately. Company D uses third party logistics for their warehousing operations and does not move the declining products to a central warehouse.

Company D keeps track of percent orders back-ordered and average back-order time for declining products as well, consistent with their high customer service strategy.

of product velocity report generations and there is no data link between legacy systems and warehouse management systems. Company C does not have an ERP system in place.

- **Further improvements:**

Company C is a unique example where their extremely strong brand, high quality product does not put much pressure on achieving supply chain efficiencies and dealing with end-of life cycle products. Unlike the previous examples, these types of products are easily liquidated through several channels where customers are readily available. As the strategic focus is on product innovation, there is much room for improvement in the new product design and launch process.

Company D:

The Company D Consumer Systems Group is a leading designer, manufacturer and marketer of a wide range of high-fidelity loudspeakers, audio and video components and multimedia systems for use in homes and automobiles, and with computers. Company D has long been recognized as one of the most socially progressive companies in US.

Although it had originated and developed in the United States, Japanese companies dominated the industry in the 1960's, and that dominance continued until the Japanese economic bubble burst in 1997. During the forty years of Japanese ascendancy, the industry was driven by strategic emphasis on market share. It was a strategy designed to force competitors out of the market, to sacrifice profit for dominance, and to recoup those lost profits from a hungry and controlled domestic market. The strategy drove competitors to respond in kind, and thus created an industry in which it was inordinately difficult to make a profit. Company D was no exception as margin pressures still continue today (information provided by Company D at their web site).

- **Product characteristics:**

- **Software support systems:**

Company D has an integrated SAP ERP system in place. Besides that there is a CPFR initiative under development with some of their key customers such as Best Buy and Circuit City. Advanced product life cycle management tools are not yet considered, as manufacturing and designing of products are mostly vertically integrated operations.

Every month, during the product review process, product profitability reports are generated for each SKU, product line, customers and distribution channels in a very detailed way. Technology is one of the key enablers for them to improve processes, forecast and overall control.

- **Further improvements:**

Company D expressed their need for a quantified system to balance inventory costs, obsolescence costs and lost sale opportunity costs and tie them to demand forecasting to make better supply chain decisions in order to reduce the write-offs.

There is also a need to reduce the lead times to be more responsive to product obsolescence.

3.3 Food Industry

Company E:

Company E, with hundreds of factories worldwide, is one of the largest food companies. Since its establishment, the company has gained vast experience through its scientific research into the nutritional needs and food preferences of consumers of all ages. In that sense, they are proud to be recognized as a major investor in fundamental and applied research and their commitment to product development is reflected in the company's mission statement.

The company's presence in United States was established in 1991. This subsidiary contributes the largest portion of worldwide revenue with sales over \$8 Billion USD in 1998. Throughout its short history, rapid growth was achieved by acquisition of other financially healthy companies while constantly diversifying the core business from petcare to cosmetics.

- **Product Characteristics:**

Company E has more than 4,000 SKUs any day both in the frozen and dry food section. The top hundred-fifty items do more than 50% of their business. An average customer will carry on the dry side 300-400 SKUs and on the frozen side 80-100 SKUs from the company's portfolio. Product life cycle is not an apparent issue. The main reasons for the slow moving inventory are:

1. Special packaging and product display modules.
2. Promotional items/SKUs, "dash packs".
3. Seasonal products such as Easter candy.

The products have as short as seven months of shelf life. Usually, half of that is allowed for retailers, and if the product spends more than four months in the warehouse, the company would not ship it to retailers. Old product is put on hold or moved to a closeout sale to get rid of the excess product. As a remedy, the company is trying to have shorter manufacturing runs and continuously improve their forecasts.

- **Supply chain:**

Maintaining a leadership position under rapidly changing circumstances requires a degree of agility not normally associated with a company the size of Company E; nevertheless, market dynamics were shifting power to large companies in the grocery and retail industry as mergers, acquisitions and strategic alliances became the name of the game. Economies of scale and scope were targeted with the ever-growing size of these mega-mergers and cutting costs throughout the supply chain was one of the primary motives. Needless to say, raising equity in stock markets, where the high-tech industry is the sweetheart, was becoming increasingly difficult for the grocery and retail industry.

Company E's customers are demanding change. The company was losing its leadership in meeting some of the key requirements from its customers:

- increasing demand and expectations for very high service levels
- increasing cost awareness under tough competition for retailers
- technological competency to better execute distribution and inventory management
- desiring solutions to provide a complete easy-to-shop assortment of products that the consumer values
- communicating the product benefits and value through advertising and price incentives

Furthermore, there was extensive buyer power limiting the company's negotiation capabilities, as the top 20 customers were accounting for 51% of total US retail sales.

Some of the challenges that company was facing in terms of slow moving product management was reflected in these statistics:

- Forecast accuracy only 40%-60%.
- \$70 MM in returns.
- Spoils rate of 1.5% of sales vs. the industry average of 0.96% (1996)
- \$16 MM of outdated/hold product
- \$50 MM in aged inventory

A new company initiative is intended to make Company E more competitive by simplifying business processes and reducing inefficiencies throughout the organization. The company consolidated most of their products and many of their plants in the past five years. They currently have multiple products made in multiple lines in a given factory, giving them more flexibility.

Company E operates six full-line distribution centers. Products that are shipped from factories to distribution centers are placed on hold and released as the clearance from product incubation is obtained. They hold some candies containing cocoa beans for salmonella testing. It usually takes seven to ten days for that process. Most of their factories are in the Mid-West, close to sources of raw material. Their warehouse in

Chicago holds all promotional and slow moving products. Many of their slow movers are repositioned there.

On the frozen side, the company uses third party facilities throughout the US, closely located to the manufacturing facilities.

Currently, company is trying to sell to the rate of consumption rather than push the product out of the door and try to make quarterly sales numbers. Efficient customer response initiatives can result in cost reductions and top-line sales growth if implemented correctly in the grocery/food industry.

- **Organization and decision makers:**

Company E learned very early to respect the social, political and cultural traditions of all countries in which the products are produced and sold. Consequently, this is a highly decentralized "people and products" oriented company rather than a systems centered organization.

A category sales development team, which works closely with marketing, is responsible for making decisions about slow moving inventories. There is also input from manufacturing and divisional accounting. In terms of everyday slow moving products, the company is not very active in eliminating those types of products. The main concern is about future lost sales, and that has been preventing SKU reduction. Usually, account sales managers work closely with respective customers and decide whether the merchandise will be liquidated or marked down depending on the level of the excess inventory.

- **Software support systems:**

Company E is in the process of implementing an SAP ERP system like the previous companies that were analyzed. They believe that in one year they will be able to transition to Activity Based Costing, which will allow them to make better profitability analysis of their products. The company is currently getting rid of "special packs", but they also recognize the need to get rid off "dogs" and streamline manufacturing

operations. Current profitability reports on products use average costs, and they are not considered to be very useful.

The existing software support is not centralized and adequate from management perspective.

- **Further improvements:**

Company E is trying to improve the synergy between strategic business units and leverage their size within a supply chain view. As discussed earlier, the most dramatic way to manage slow moving products and excess inventory is ECR implementation. Nevertheless, there are tremendous change management issues especially in the food/grocery industry. Instead of regarding trading partners as potential competition, companies need to actively establish cooperative relationships with selected trading partners. Rather than Company E developing products and selling them to, and through the retailers, they must jointly identify and target products needed to support an enhanced consumer offering. Information about up-to-date views of real demand need to be shared amongst supply chain partners instead of being closely guarded.

Instead of a zero-sum game, ECR requires initiatives to be mutually beneficial. Historically, information represented power, and sales data was not generally available unless purchased from retailers. Company E needs to convince the retailers about this significant cultural change in order to have a successful ECR implementation. For the company, this change in attitude means moving away from a push mentality and competing on share of shelf space, to establishing a strong strategic position in the category, which contributes to overall category growth. For both Company E and its retailers it means gaining better understanding of the consumer at the point of purchase and using sales to pull replenishment.

To make ECR work, there needs to be specific improvements in these following cross-functional area (Sharpe, Hill, 1998) as shown in figure 9:

- Demand management, which covers those activities, focused on improving the product offering to consumers.

- Supply management, which covers several initiatives designed to improve the flow of the product through the supply chain
- Enabling technologies, which are activities that act as enablers for the other ECR improvement concepts, many of which are related to electronic commerce.

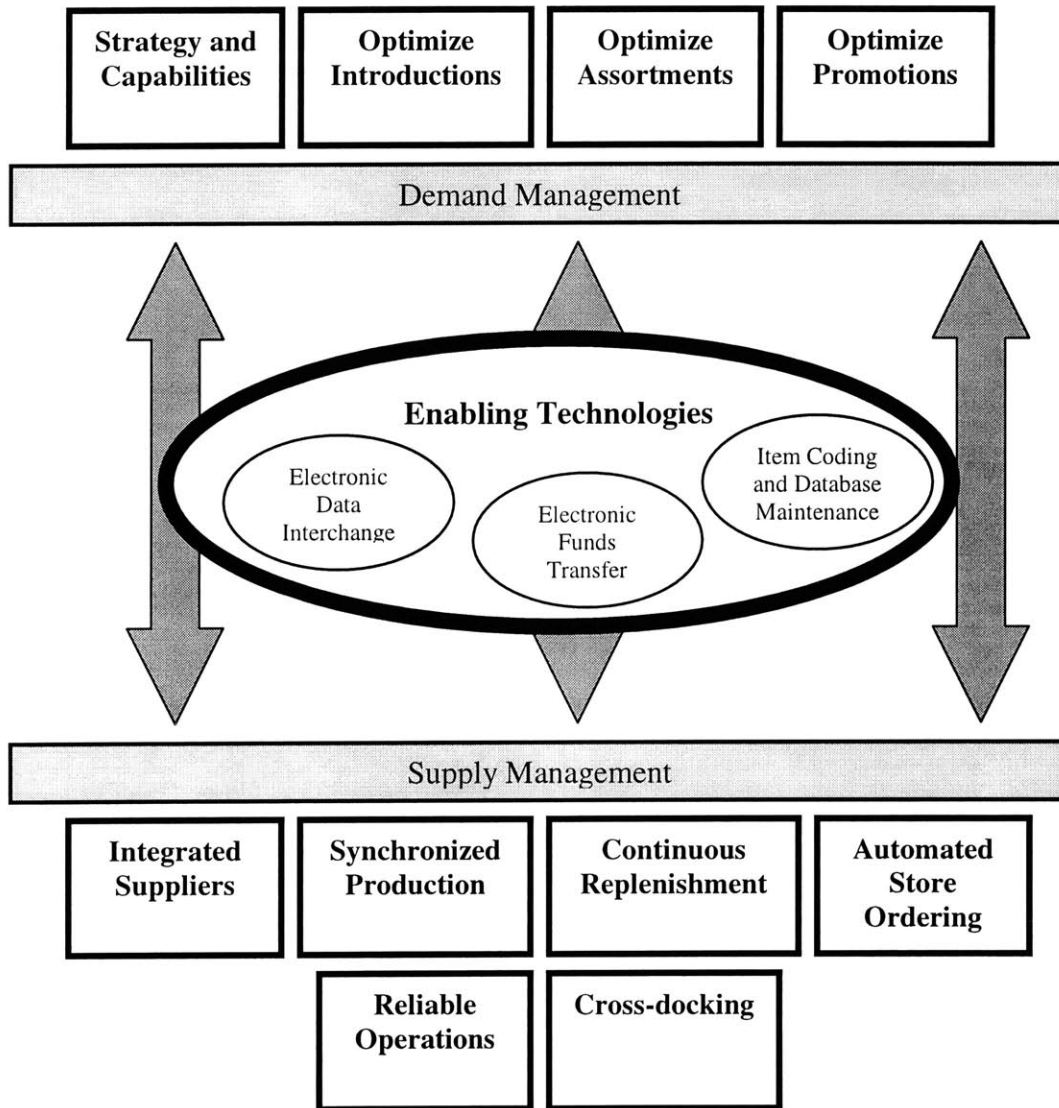


Figure 9. ECR Improvement Concepts

3.5 Retail Industry

Company F:

Company F is one of the leading office-supply chains in the country, with over \$8.5 billion in annual sales. Now, it is moving aggressively to create a major online presence and the strength in its regular and direct retail operations gives them an advantage over other B2B players. The company already has a large base of business customers, sales momentum in the online space, great brand recognition and a sophisticated hub-and-spoke distribution network to support the growth, which is already in place. It should be noted that the company is operating in an environment that is highly competitive on service, flexibility and cost.

In order to further leverage their investments, it is remarkable to see that Company F is setting itself up to potentially become an application service provider (ASP) for the small-business customer. In this scenario, their online operations would become the virtual destination site that would host a small business's software and data and would also provide the capability to facilitate their payroll, taxes, human resources, legal and related administrative tasks over the online ASP platform. These services could be offered a la carte or as a package, depending on the customer's requirements. The services would not necessarily be a company's own product, but they would be hosted on their Web site. ASPs will be covered in Chapter 4 in more detail.

- **Product characteristics:**

Product groups group the main products provided by Company F, namely: furniture, business and communications machines, technology products and office supplies. All together about 8500 SKUs are being actively managed in the company.

Although the number varies from product to product, on technology items, product life cycle changes from two years to six months. The relative high value of these products makes item selection and presentation a crucial issue. As an example, when the company decides to have 2-3 demo items for copiers in each store, the total inventory can go up as much as three million dollars on a single SKU.

For these reasons, there is a close focus on merchandising practices. Review of declining products is happening daily, resulting in 30% year over year product-offering change. Some of the main reasons for product elimination are older technology, technical defects with the product, better substitutes that are offered by competitors and most importantly, profit margins being below target level.

- **Supply chain:**

“Supply chain management is the company” as mentioned by one of the key executives. Figure 10 shows how the company is reaching to different customer segments. Company F is currently view e-commerce as an another channel where they can further improve their asset utilization by having a common order processing and distribution system.

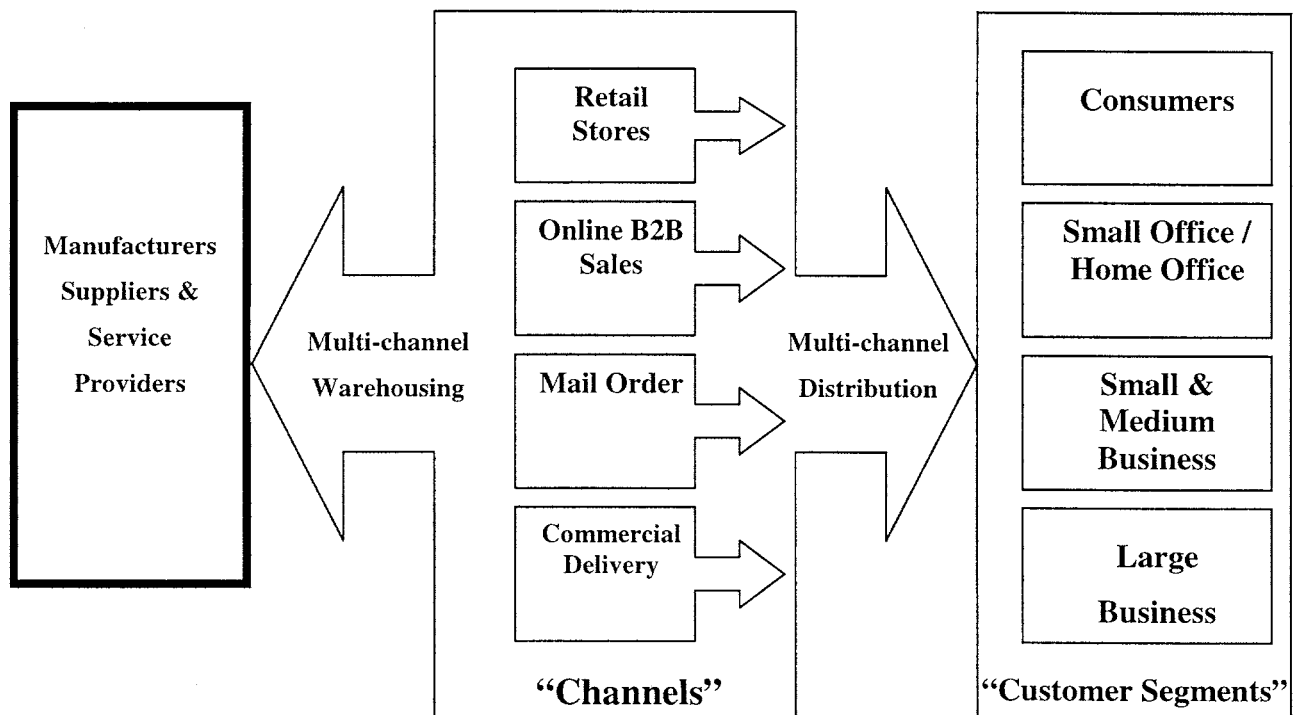


Figure 10. Reaching to customers (Courtesy of Company F)

The company also strides in integrating e-commerce into its retail stores, adding Intranet special order kiosks in its entire US stores. It is interesting to see that for some of the products with short life cycle and high-value, company F chose not to carry any inventories other than for demo purposes. As an example, they enhanced their PC

business through build-to-order computer offerings from Compaq and Hewlett-Packard that enable customers to customize their own PC without the company carrying the inventory risk.

The supply chain in Company F can be described with the following diagram (Courtesy of Company F):

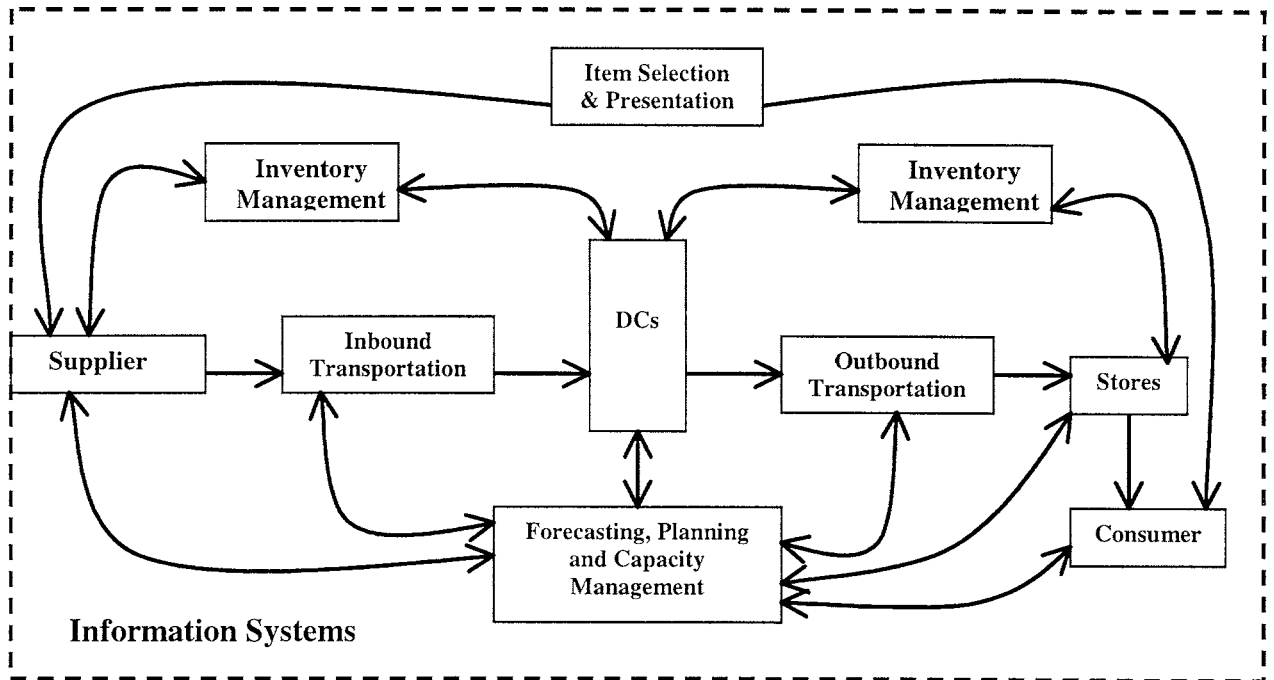


Figure 11. Supply Chain Management at Company F

As it can be seen from the diagram, at the heart of the supply chain is item selection and forecasting. Also inventory management is critical to the company like many big retailers. Particularly, the company’s initiative on declining and slow moving product management is seen as a primary focus.

On the delivery side, Company F significantly improved service and efficiencies by rolling out three new multi-channel distribution centers to serve the company’s contract, catalog and e-commerce customers and a multi-channel call center in Halifax, Nova Scotia and by adding 400 new trucks to its delivery fleet. Interestingly, Company F is

having a lot of back-haul opportunities during their delivery routes, mostly for their suppliers.

- **Organization and decision makers:**

Merchandising makes product portfolio and retirement decisions under the retail division, reporting to Chief Operating Officer & President of the company. It is no surprise that the executive vice president of the supply chain management, which is both centralized and divisional, also reports to the same person.

Once declining products are identified, Company F takes a course of actions including searching for productivity increases, decreasing the price of the merchandise and making adjustments in inventory and warehousing. Before actually abandoning the product, the company considers market share, supplier issues, alternative usage of released assets, potentially missed sales revenue, logistics cost impact and liquidation value in an analytical model.

An inventory management group within the supply chain management organization manages actual deployment of inventory for end-of-life and other products. The company operates two-tier distribution networks, and slow moving products are moved back to main distribution centers. At that point, inventory levels and service commitments and in-stock availability for those items are reevaluated. In parallel, they also change the item selection and presentation of declining products for all customers and communicate these decisions one-month in advance to channel partners and consumers. Company F keeps track of actual fill rate for declining products, consistent with their high service standards.

- **Software support system:**

Unlike the previous cases, Company F does not have an ERP system in place; however, there is a very strong IT support that wraps around all of the decision making processes. The IT organization matrixes to all divisions except the online sales unit which manages their own website. Company F's own sophisticated forecasting and replenishment system uses point of sales data, on hand inventory of each store, and the effects of seasonality.

In order to help with SKU rationalization, monthly profitability reports are generated for each product and product line.

- **Performance metrics:**

Company F uses EPS, RONA, sales growth and stock price as the main metrics to evaluate their performance. Company F tries to balance their high service commitment and supply chain costs. Last year, they were able to increase store fill rates while improving inventory turns.

- **Further improvement:**

Despite all these initiatives, company executives believe that there is not enough focus given to slow moving and obsolete items by the merchandising team. Supply chain executives believe that if inventory turns and sales improvements have equal weight in the eyes of the top management, their job would be easier.

A CPFRR initiative would also be useful to coordinate promotions, lower post-promotion inventory levels and minimize “special buys”, all causing excessive inventory which gets obsolete in a short period.

More sophisticated assortment planning can be implemented by finding out the correlation between store area demographics and special events, such as school openings and merchandise offered.

Company G:

Company G is the leading retailer in the country. Their devotion to building customer loyalty through everyday low pricing and high availability of goods was the main contributor to their rapid growth over the last decade. The company’s success is primarily based on achieving efficient inventory replenishment through cooperation with channel partners.

One of the many innovations that Company G was involved in was a new information-sharing system over the Internet, called CFAR (Collaborative Forecasting and

Replenishment). The system improves reliability of longer-term forecasts, which in-turn eliminate excess inventory, rework, excess labor and waste. There is extensive information sharing amongst channel partners, where real time store sales are monitored across the supply chain.

There are many articles written on the supply chain practices of the company that are beyond the scope of this study; however, it is important to elaborate their forecasting processes within the context of slow moving inventory management.

- **Product characteristics:**

From the retail perspective, Company G manages about 125,000 SKUs. Since many retailers like Company G base their offering on having a broad assortment to provide “one-stop shopping,” SKU (Stock Keeping Unit) counts are relatively high.

There are primarily two types of product categories: seasonal products and basic replenishment products. Typically, seasonal products like lawn mowers are reviewed annually or whatever their season is. Based on sales, trends and all other forecast indicators, these products are reviewed each year starting with a clean sheet. The basic goods are reviewed on every replenishment cycle, that could be daily, weekly or occasionally every other week.

Based on buying and delivery frequency, each product’s Economic Order Quantity (EOQ) is calculated. The main driver for EOQ calculations is the predictability of demand for each SKU and high volume, highly variable products with low predictability are the ones that retailers like Company G needs to place special attention. Newly introduced models with unknown demand, end-of-life cycle products and products that sell year round in low quantities are particularly difficult to forecast and manage.

- **Supply chain and forecasting:**

Company G manages a complex logistics system. In a nutshell, typically merchandise moves to the consumer in one defined “stop”, usually to consolidate the goods from multiple vendors into the company’s distribution centers. Store demands are pooled to

create efficient and fast replenishment orders from each vendor that are then combined with other in the company's outbound shipping network. Inventory is mostly managed by vendors with the goal to reduce deployed inventory at the store level.

One of the cornerstones in improving customer service levels, inventory turn rates and gross sales is establishing a forecasting process that is integral to Sales and Operations Planning. In Company G, forecasting starts with an unconstrained baseline numbers generated using demand history, marketing and customer inputs. On the other hand, operational constraints such as supplier capacity lead times and logistics capabilities are collected. Finally, demand, order and inventory forecasts are decided through a consensus meeting.

Forecasting model in Company G incorporates four distinct elements:

- ◆ **Time Series:** A product's sales history is used to predict the future.
- ◆ **Product Life Cycle:** Using the demand history of "like" prior products or product lines over their life or year of life.
- ◆ **Causal Analysis:** Using cause-effect relationships among sales versus promotional activities, price and competition.
- ◆ **Expert Opinion:** Using expert advice from consumer surveys, sales staff, senior executives and industry experts.

It is important to note that forecast of all SKUs are being done in a closed loop process where performance is constantly checked and forecast is renewed. Declining products are easily spotted as the system identifies items that are performing outside planned tolerance levels. Company G has a special process (Phased-in/Phased-out) that recognizes the profiles of these types of products during merchandise ordering.

Store level forecasting used to set stock assortments by SKU requires a very different approach. The vast majority of items have a low rate of sale at SKU level so the volatility of the sales is the important factor, not the average level.

- **Organization and decision makers:**

In Company G, general merchandise managers reporting to VP of Merchandising are involved in the decision making process. They do monthly reviews of products in order to find declining ones. As in previous cases, market share, customer loyalty, supplier relations and potentially missed revenue are considered before abandoning a product and the company have a standard process to evaluate those. Once a declining product is spotted, the company considers new promotions together with adjustments in inventory and warehousing simultaneously.

Also, product profitability reports for each SKU, product and product line are prepared every month and used to help with the product abandonment decision. Once the declining products are spotted, in-stock availability targets are also adjusted depending on the discretion of store managers.

▪ **Software support system:**

Company G has very strong IT support which enables them to process terabytes of sales data collected through point-of-sale. Furthermore, real-time data visibility is provided to most of their suppliers to keep track of their product movement throughout the supply chain. Given the complexity of their operations and magnitude of their sales, best of breed products are being used in their forecasting and inventory management decision support software, some of it being custom developed by IBM.

Company G's drive for forecast accuracy is reflected in their implementation of product life cycle management to their decision support tools. They are at the leading edge of technology and a benchmark in supply chain management.

▪ **Further improvements:**

Company G uses sophisticated algorithms requiring technical systems knowledge in their existing store and warehouse replenishment systems. System parameters such as lead times should be maintained by a group of people with appropriate core competencies in merchandising.

In the next chapter, an analysis of software tools enabling the management of declining products is provided.

4. SOFTWARE SUPPORT FOR MANAGEMENT OF DECLINING PRODUCTS

A great number of supply chain tools have been available for the last 3-4 years to provide intelligent decision support and execution management. Although companies like i2 Technologies come close to providing complete decision support, no single tool provides the complete range of desired capabilities to manage today's complex supply chain systems. In the absence of a total packaged solution, many companies are looking to link their Enterprise Resource Planning (ERP) systems with "best-of-breed" supply chain planning and real-time-decision support tools connecting not only enterprise-wide systems but also with those of their suppliers, distributors and end-customers.

Traditionally, ERP tools were not considered under the category of supply chain management tools. However, many manufacturers now view ERP systems as the core of their information technology strategies on which to build their supply chain management solutions. Companies with global operations especially felt the pressure in terms of scalability of their separate systems, and have moved to implement an ERP solution to have common data visibility and business processes throughout the enterprise. These enterprise-wide transactional tools captured all kinds of data and reduced manual activities and tasks associated with processing financial, inventory and customer-order information. ERP systems provide an infrastructure for better product life cycle management tools required by demanding market conditions including:

- Shorter product life cycles
- Product proliferation and customization
- Increased pressure on profit margins

Two of those products are i2 Technologies' RHYTHM Product Lifecycle Management and SAP's Product Lifecycle Management.

4.1 Product Life Cycle Management Software

In this area two companies have specific products for the management of product life cycle: SAP and i2 Technologies. Both products acknowledge the emerging view that a

total Product Life Cycle Management Process is required with a much broader business process than the individual product engineering process. Critical activities and decisions are supported by these modules through the management of product portfolio, technologies and resources from design to phase out, in order to achieve maximum growth and lifecycle profitability. This is a cross-functional process that is closely linked to business processes and systems such as forecasting, demand planning, supply chain management and strategic capacity planning according to both companies.

Both companies have a strong emphasis on integrated and collaborative product development process. I2's software focuses on improvement actions grouped in five main categories:

1. **Product Strategy and Portfolio Planning:** This is geared towards managing product development investments by optimally allocating investments in new versus existing products.
2. **Product Requirements Planning:** It is mainly identifying and incorporating customer needs while trying to achieve shorter time-to-market.
3. **Development Scheduling and Resource Planning:** It is mainly project management for new product development.
4. **Design Sourcing and Reuse:** This is an improvement action with the intent of leveraging common parts and suppliers in order to extend product lifecycle and lower costs throughout the supply chain.
5. **Product Transition Planning:** Integration of activities from development, marketing and supply chain to manage product transitions.

I2's RHYTHM Product Lifecycle Management (PLM) has two core modules:

- **PLM Planning Solutions** which include RHYTHM Portfolio Planner, RHYTHM Requirements Planner, RHYTHM Development Scheduler, RHYTHM Design Optimizer and RHYTHM Transition Planner. The modules span all the major phases in the typical product development and product lifecycle process, from early concept

definition, through development and test, launch, to product phase-out. The tools provide support for strategic long-term issues and operational short-term execution. It can be implemented as an integrated solution, or phased in gradually, i.e., linked to introducing new work processes.

- **PLM Design Collaboration Solutions** which include Requirements Collaboration, Project Collaboration, RFQ Collaboration and Design Change Collaboration. These are Internet-based business capabilities to build a highly collaborative community for product development professionals.

I2 Technologies believe that their PLM product is unique in terms of providing a complete solution by offering these key-values:

- Increased profitability and revenue by optimizing bottleneck resources through more profitable products.
- Improved revenue stream by reducing time-to-market with respect to design and supply chain constraints.
- Increased development productivity through web collaboration, reusable product modules and better design visibility.

Unlike i2, SAP Product Lifecycle Management provides users Web-based access to all product and process data for the entire life cycle of the product as an integrated part of their mySAP.com portal. This portal enables the collaboration of business partners by means of a custom configured web interface. All of the functions are also available directly from SAP System. In a nutshell, SAP Product Lifecycle Management covers these functions:

Basic Data Management: It provides a clever way to create a knowledge base for the configuration of a wide variety of complex products.

Document Management: It links the administration and distribution of technical designs with the company-wide information flow. Document security management, such as authorization is an important feature of the product suite.

Change and Life Cycle Management: Product change processes initiated in design are integrated with costing, planing or production and controlled.

Engineering Process: With the mySAP.com portal, developers, design engineers and engineers have a central point of entry for work for further collaboration.

Integration: CAD/CAM systems are connected to the ERP system.

Product Management: Cost controls, budgeting, project schedules and resources are managed in an integrated way with the ERP system.

The SAP philosophy in its PLM module is based on managing product and design data in centralized way before the manufacturing, as 80% of a product's eventual cost is determined during that period. It is much more focused on product development than product management and, therefore, it is not appropriate to actually name this a complete PLM module like i2 Technologies' solution set. Although the name of the software implies complete product life cycle management, in reality, it falls short of expectations. SAP's Enterprise Management suite, which includes strategic enterprise management, business intelligence and data warehousing and managerial/financial accounting, is more appropriate for product and portfolio management analysis.

Under these circumstances, i2 Technologies' solution comes close to providing a complete solution. Nevertheless, the value that it creates needs to be evaluated on a case-by-case basis with i2 consultants.

It should also be noted that demand planning or forecasting modules offered by companies like Manugistics and Logility specifically address the product life cycle scheme in their processes with easy to use interfaces. In particular, Logility's Voyager Solutions offer web-based collaboration throughout the supply chain between channel partners for a large number of SKUs and it is suitable for the retail industry. Other important players in this area are Syncra and Retek, both best-of-breed products designed for a particular industry in mind.

In the retail industry where today's customers are growing in sophistication, demanding excellent service and quality product combined with broader product ranges, data warehousing is a great tool helping the companies to understand the customers' behavior. A study conducted by Kurt Salmon Associates in 1997 found that all four software

vendors including Information Builder, SAS Institute, Valstar, and Business Objects were offering well balanced and competitive products.

Despite all their potential benefits, decision support tools focused on product life cycle management face these questions for their evaluation: what are the customer value and payback period for the software? (Figure 12). The key to benefit realization is to build a rigorous business case and obsessively using it as the driving force of implementation. Industries where product life cycle is as short as six months to one year, product proliferation is high, and liquidation of end-of-life cycle products is very difficult can make the business case more easily for complete PLM products such as offered by i2 Technologies.

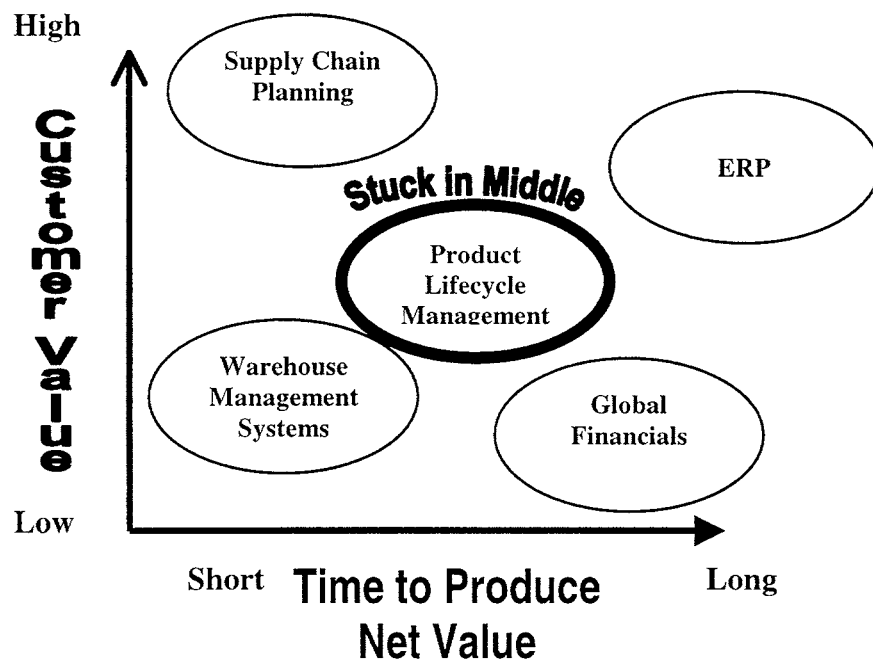


Figure 12. Evaluation for Decision Support Tools (Adapted from Gartner Group)

4.2 Future Trends

According to Scott McNealy (McNealy, 2000), CEO of Sun Microsystems, five years from now companies will no longer be buying computers or software. All these resources will be rented from service providers. On the software side, an Application Service

Provider or ASP is a company that hosts and manages business applications on behalf of a client. These applications can range from basic e-mail to groupware and data mart applications to extremely complex and demanding applications such as Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM).

The value proposition of the ASP is very compelling: take advantage of the ASP's expertise and economies of scale in managing applications, and avoid the pain and expense of hiring your own specialists and constantly installing, maintaining, and upgrading packaged software.

With ASPs, you can have top-tier business systems right away for a predictable monthly fee, and this argument is very powerful for the future Product Lifecycle Management software that may have periodic usage unlike other decision support tools.

In general, it makes sense to consider outsourcing a business application if it:

- Requires special skills to design, deploy, and maintain.
- Does not require value-add from IT to be used successfully. If the application is broadly available and provides full functionality in its packaged form, it may make sense to outsource it.
- Cannot be delivered more effectively or cost-efficiently by IT. In the .com age, it is often good advice to reserve internal management of applications for the most specialized projects and to consider outsourcing all other applications.

According to Sun Microsystems, the leading ASPs are (EcNet) Advanced Manufacturing Online, Asera, Bid.Com, BigStep.com, BT, CSC, Corio, Dorado, EDS, eOnline, Infocast, Interpath, KPN, MT&T, Navisite, NetASPx, Portera, SaskTel and USi. Software vendors such as PeopleSoft, Oracle, i2 Technologies and Manugistics are reviewing their business models to become partners of ASPs as this is written.

4.3 Proposed Enhancements

One of the key starting points in the management of a product portfolio is coming up with accurate costing and product profitability figures before any decision. ERP systems have been capturing transactional data and utilize it in activity based costing. On the other hand, new methodologies focusing on cost allocations of manufacturing performance thereby linking profitability to operating metrics could be embedded to those systems. These types of measures will reflect the relative manufacturing efficiency of products within a product line assuming that non-material costs are incurred to support the availability of manufacturing time on machines (assumed to be bottleneck resources). Capital intensive industries, where we assume that a common machine or sets of machines manufacture all the products, are the main targets for this type of profitability revision.

Sometimes, although a product has been declining, it is not always wise to remove it from production due to strategic competitive issues and other product interdependencies. Many times the knowledge about these type of product characteristics is kept within a department, typically marketing, and is not shared across the enterprise. Software vendors must be able to capture this type of information within revised data models and make it available to other departments.

Finally, there is further need for optimization modules capable of incorporating uncertainties in the forecasts when there is a likelihood of possible product obsolescence. Market obsolescence for a product may occur due to changes in consumer perception or technological changes, and may not be related to physical newness at all. Decision support models need to be developed and embedded in software combining the newsboy problem and integer linear programming approach. Particularly decision support software specializing in the retail industry needs to be able to recommend the optimal assortment given the retailer's inventory costs.

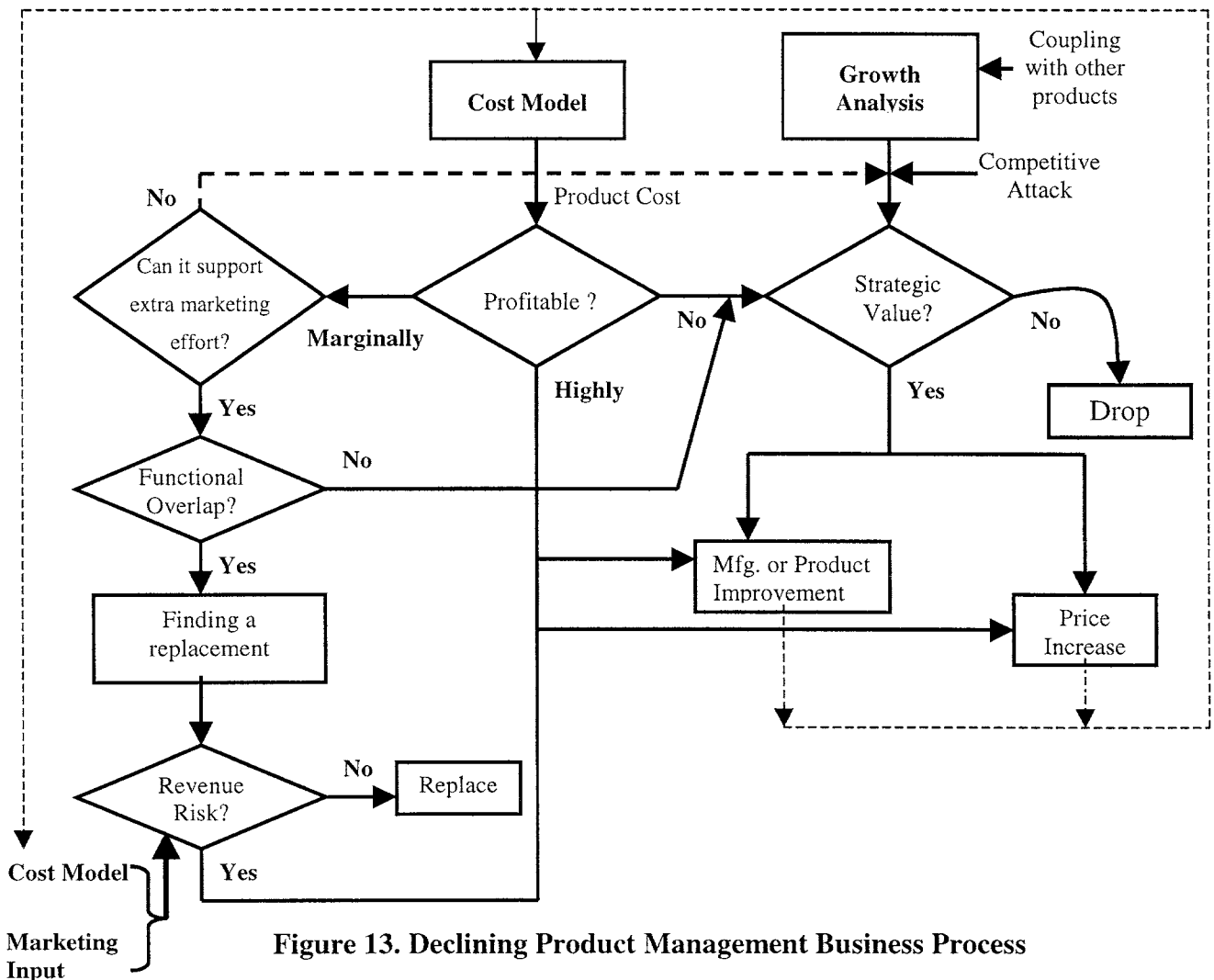
Finally, Gross Margin Return on Investment (GMROI) can be a very useful tool in portfolio analysis. It is a measure of inventory productivity that expresses the relationship between the total sales, the gross profit margin you earn on those sales and the number of

dollars invested in inventory. The formula for finding GMROI as a percentage is $GMROI(\%) = \text{gross margin}(\%) \times [\text{sales} \div \text{average inventory at cost}]$. Using GMROI as a measuring tool, companies can compare the relative value of every piece of merchandise they carry and draw conclusions about where they should be concentrating their efforts to achieve maximum profitability. Software vendors should be including this metric in analysis provided by inventory management and product lifecycle management modules.

5. CONCLUSION

The purpose of this research was to find out the individuals involved in management of end-of-life cycle products, the decision process used, the criteria to identify declining products, their impact on supply-chain across many industries and software systems to support the process. The research involved seven companies from a wide range of industries including retail, consumer electronics, medical devices, network equipment and food. All of the companies analyzed in this study are considered to be leaders in their areas with multi-billion dollars in revenue.

Five out of seven companies reported that there is a formal business process involved in managing declining products through a product review procedure.



This process is more rigorously and frequently followed in retail and high-tech companies where the average product life cycle ranges from six months to one year. The frequency of the product revisions changes from monthly reviews in the retail industry to yearly ones in the food sector.

A typical business process has product costing and marketing input at the heart of it. If a declining product is found to be unprofitable, then its strategic value with respect to competitive actions, segment growth and its coupling with other products is evaluated. Figure 12 represents a common business process derived from this research. Immediate drop and harvesting are the most common set of actions for declining products. Also, increase/decrease in price, reducing manufacturing costs and replacement with new product are common strategic alternatives to product abandonment.

Decision-makers throughout this process are mostly from the marketing department. In companies with high brand awareness, marketing people have the absolute power, and this was particularly the case in the consumer electronics industry. When supply chain becomes the core of the strategy, then a centralized supply chain organization is involved in the decision-making process. In the retail industry, the merchandising department manages the product portfolio; however, operational decisions, such as management of inventory levels for declining product and their repositioning, are made by supply chain people. When the declining product can not be liquidated and excess inventories are usually written-off, as it is the case with medical devices industry, supply chain managers have the complete authority in decision-making process.

In the high-tech industry, many companies are adopting a built-to-order model resulting in less finished goods inventory and risk of obsolescence. Due to the highly competitive nature of the market, they adopt planned obsolescence in their product management. Although products are renewed as frequently as every six months, special attention is being given to the new product development efforts where modular designs and common parts are used in order to extend product life cycle.

Six out of seven companies analyzed had an ERP system in place and are actively using it for product profitability analysis. Only two of them were aware of the existence of

product life cycle management software, mainly due to its new presence in marketplace. Most of the companies want to use decision support tools offered by their ERP vendor; however, large retailers, who believe that IT is their core competency, prefer to develop custom software with their technology partners and go with the “best-of-breed” solution.

High-tech companies and retailers were using the web to enable their decision making for declining products. It is the author’s belief that more and more retailers will switch to Internet devices as a new channel to provide declining, slow-moving and expensive/short life cycle products such as PCs rather than carrying them in stores.

The Internet also offers a new channel for liquidating declining products without extensive losses in the consumer electronics and networking industry. These sales are usually done through a company’s or distributor’s website. In some cases, company owned discount stores are used to sell excess inventory and end-of-life cycle products.

Despite all their efforts, the common belief among management ranks is that not enough attention is given to the management of declining products. Luckily, a new set of web-enabled decision support tools is emerging to help with this process, from new product development to product portfolio management. It is expected that they will also be available by ASPs as this industry’s revenues are projected to grow to \$2 billion by 2003 according to the technology research firm IDC.

REFERENCES:

“The ASP Boom,” *How to.com: Case Studies*, Sun Microsystems Web Site
(www.sun.com)

Alexander, R. S., “The Death and Burial of ‘Sick’ Products,” *Journal of Marketing*,
Volume 28, April 1964.

Anderson, Carl R. and Frank T. Paine, “PIMS: a Reexamination,” *Academy of
Management Review*, July 1978, pp. 602-612.

Austin, Terry, “The Personal Computer Supply Chain: Unlocking Hidden Value,”
Strategic Supply Chain Alignment, Gower Publishing, UK, 1998, pp. 188-195.

Cottrill, Ken, “Speedier Supply Chains,” *Journal of Commerce*, February 7th 2000, pp.16.

Day, George S., “Diagnosing the Product Portfolio,” *Journal of Marketing*, April 1977,
pp. 29-38.

Dhalla, Nariman and Sonia Yuspeh, “Forget the Product Life Cycle Concept!,” *Harvard
Business Review*, January-February 1976, pp. 102-112.

Fine, Charles, “Clockspeed-Winning Industry Control in the Age of Temporary
Advantage,” *Sloan School of Management*, Perseus Books, Reading, MA, 1998.

Fitzroy, Peter T., “Analytical Methods for Marketing Management,” *McGraw-Hill*,
England, 1976.

Forrester, Jay W., “Market Growth as Influenced by Capital Investment,” *Industrial
Management Review*, Volume 9-2, 1968, pp. 83-105.

Gattorna, John (edited by), "Strategic Supply Chain Alignment," *Gower Publishing Ltd.*, England, 1998.

Hamelman, Paul W. and Edward M. Mazze, "Improving Product Abandonment Decisions," *Journal of Marketing*, April 1972, pp. 20-26.

Johnson, L. and D. Montgomery, "Operations Research in Production, Scheduling and Inventory Control," *Wiley*, New York, 1974

Kotler, Philip, "Harvesting Strategies for Weak Products," *Business Horizons*, August 1978, pp. 15-22.

Lambert, Douglas M., "The Product Abandonment Decision," *National Association of Accountants and The Society of Management Accountants of Canada*, 1985.

Machlis, Sharon and Jaikumar Vijayan, "Retailer Chooses Web to Sell Surplus," *ComputerWorld* (www.computerworld.com), January 18th 1999.

McNeally, Scott, "Stop Buying Software," *How to.com: Executive Perspectives*, Sun Microsystems Web Site (www.sun.com), April 4th 2000.

Michael, George C., "Product Petrification: A New Stage in the Life Cycle Theory," *California Management Review*, 1971, pp. 28-31.

Moore, Geoffrey A., "Crossing the Chasm: Marketing and Selling the Technology Products to Mainstream Customers," *HarperColins Publishers*, New York, 1991.

Pessemier, Edgar A., "Product Management," *John Wiley & Sons*, New York, 1975.

Polli, Rolando and Victor J. Cook, "A Test of the Product Life Cycle as a Model of Sales Behavior," *Market Science Institute Working Paper*, November 1967, p. 43.

Robeson, James F. and William C. Capocino, "The Logistics Handbook," The Free Press, New York, 1994.

Smallwood, John E., "The Product Life Cycle: A Key to Strategic Marketing Planning," *MSU Business Topics*, winter 1973, pp. 29-35.

Trommer, Diane, "Dell Expands Net Strategy to Supply Chain," *Electronic Buyers News Online* (www.ebnonline.com), June 5th 1998.

VESA – Video Electronics Standards Association, "VESA Adopts Digital Flat Panel Standard," *VESA web page* (www.vesa.org/pressroom.html), March 29th 1999.

Weitz, Barton A. and Robin Wensley, "Strategic Marketing: Planning, Implementation and Control," *Kent Publishing Company*, Boston, MA, 1984.

Wensley, Robin, "Strategic Marketing: Betas, Boxes or Basics," *Journal of Marketing*, summer 1981, pp. 173-183.

Worthing, Parker M., "Improving Product Deletion Decision Making," *MSU Business Topics*, summer 1975, pp. 29-38.

Worthing, Parker M., "The Assessment of Product Deletion Decision Indicators," *FORTTRAN Applications in Business Administration*, Ann Arbor, MI: Graduate School of Business, 1971

APPENDIX: End-of-Lifecycle Management Survey Form

Instructions: The purpose of this survey is to collect data about companies' practices on their business processes managing declining products or product groups. The questions are grouped under four sections: general information, marketing, finance and supply chain considerations. Please respond to all questions and provide your feedback on issues you find appropriate. Thank you for your interest, participation and invaluable time.

General Information:

What is your company's name:

Which industry group best classifies your company's activities?

- Consumer Electronics
- Telecommunications/Networking
- Apparel
- Electric/Electronic Equipment Distribution
- Retail

How would you describe the competitive environment in your industry?

Does your firm have a formal business process for management of declining products and product abandonment?

- Yes (Can I obtain a copy?)
- No

Division: Title: Report to:

Who is responsible and involved in decision making process? Please list the titles and their place in organization hierarchy.

How frequently do you review declining products? Annually
 Every six months
 Quarterly
 Monthly

How many products or product groups do you have?

Last review:

How many products or product groups did your firm eliminate in the last two reviews? Previous review:

Do you anticipate that the number of eliminated products will go up in future? Yes
 No

If yes, please mark the top three reasons. Future sales forecast is pessimistic
 Current sales volume is substantially lower than the forecast
 Sales volume is following a clearly declining trend
 Poor profitability
 Old technology/Technical defects
 Better substitutes were introduced by competitors
 Government Regulations
 Overall Market share is declining
 ROI is below the target
 Other (please specify)

What is the average life-time of your products? Years / Months

Do you have product or product groups with different product-life cycle characteristics? Yes
 No

Is there a framework to categorize products? No
If yes, please indicate. Yes, Profitability
 Market Share
 Growth Potential
 Other (please specify)

Once a declining product is identified, what courses of actions are taken?

- Searching for productivity increases
- Modification of product
- Decreasing the price
- Decreasing the promotion
- Increasing the promotion
- Adjustments in inventory and warehousing
- Adjustments in transportation
- Repositioning the product
- Others (please specify)

Were the following costs and issues considered when abandoning a product?

- | | |
|--|---|
| <input type="checkbox"/> Market share | <input type="checkbox"/> Potentially missed sales revenue |
| <input type="checkbox"/> Customer loyalty | <input type="checkbox"/> Logistics cost impact |
| <input type="checkbox"/> Intangible assets (patents, trademarks) | <input type="checkbox"/> Liquidation/salvage revenue |
| <input type="checkbox"/> Employees | <input type="checkbox"/> Other issues |
| <input type="checkbox"/> Suppliers | |
| <input type="checkbox"/> Alternative usage of released assets | |

Have you gone through an ERP implementation?

- Yes
- No

If yes, please identify the ERP solution.

- SAP
- Baan
- Oracle
- PeopleSoft
- JD Edwards
- Other (.)

Do you have a decision support system (DSS) implemented for product life cycle management?

- Yes
- No

If yes, please identify the DSS solution.

- I2 Technologies
- Manugistics
- SAP APO
- Other (.)

Do you have a CPFR initiative in place? Yes
 No

Supply Chain Considerations:

Can you distinguish your company through superior logistics capabilities in one of five areas of differentiation? Low cost, superior efficiency
 Superior customer service, in-stock availability, correct order
 Value-added services: quick responses, continuous replenishment, drop shipments etc.
 Flexibility: customized service and cost of individual accounts
 Innovation in service: capability to regenerate new values and competitive advantage.

How can you categorize your firm's logistic organization? Centralized
 Divisional
 Combination of centralized and divisional
 Separate Division

"Once declining products were identified,"

Did your firm revisit the channel structure? Yes
 No

Did your firm inform channel partners/consumers ahead of time of the deletion decision? Yes
 No

If yes, please indicate the number of months _____

Did your firm involve channel partners in decision making process of product deletion? Yes
 No

Did your firm redefine which customers were served from each facility? Yes
 No

Did your firm reevaluate the new inventory levels for those products? Yes
 No

Did your firm reposition those products to higher echelon warehouses? Yes
 No

Did your firm redefine new in-stock availability targets for those products? Yes
 No

Did your firm changed reverse logistics operations for those products? Yes
 No

Did your firm utilize third-party logistics for those products? Yes
 No

Is there a special order management process for those products? Yes
 No

Is there a special forecasting process for those products? Yes
If Yes, please elaborate: No

Please indicate if any of these inventory cost elements were reevaluated for those products.

<input type="checkbox"/> Inventory holding cost
<input type="checkbox"/> Shortage cost
<input type="checkbox"/> Backorder cost
<input type="checkbox"/> Order processing cost

Did your firm change the method of shipment for those products? Yes
 No

What is the method used to account for inventory? FIFO (first-in, first-out)
 LIFO (last-in, first-out)
 Average Cost (i.e., moving average)

Does your firm perform cycle counting? Yes
 No

Do you use different inventory accuracy level for declining products, C items? Yes
 No

Do you keep track of any of these performance statistics for your core customers?

- Actual Fill Rate
- Minimum acceptable fill rate
- Percent orders back-ordered
- Average back-order time
- Maximum acceptable back-order time

Do you keep track of those statistics for declining products?

- Yes
- No

Do you have an inventory aging schedule and valuation table?

- Yes
- No

Do you have business procedures about servicing/spare parts for abandoned products?

- Yes
- No

Marketing Considerations:

For declining products, which of the following strategies are employed?

- Reduction in manufacturing costs
- Modification of product
- Increase in price
- Decrease in price
- Increase promotion
- Decrease promotion
- Increase sales force effort
- Decrease sales force effort
- Increase market research
- Change supply-chain strategy
- Reposition product
- Compete in market niches
- Trim product line
- Replacement with a new product

For products being abandoned, which of the following strategies is employed?

- Dropping immediately
- Harvest – reduce investments while attempting to harvest earnings
- Slowly retiring
- Combination of policies

Does your firm attempt to liquidate/sell the abandoned product? Yes
 No

Financial Considerations:

If a product/product group is abandoned, are overhead and/or joint costs reassigned to remaining products? Immediately
 In next year's plan
 Other

Are product profitability reports prepared by: SKU
 Product
 Product line
 Customer
 Distribution channel

How frequently are they prepared: Weekly
 Monthly
 Quarterly
 Semi-annually
 Annually
 Other (please specify)

Are product profitability reports prepared by: SKU
 Product
 Product line
 Customer
 Distribution channel

Please provide your opinions for the following questions:

- **What is wrong with the way you do business, currently?**

- **What are the strengths of your organization? What is working well currently?**

- **What would you like to see as improvement in your organization?**

- **How do you measure success in your organization?**

- **What are the enablers to improve the performance of your organization?**

- **How can I improve this survey?**

