Chapter 1
Introduction

What has changed in business over recent decades is the amazing proliferation of product choices in almost every product category. In order to compete, manufacturers are fighting one another for market share either by offering more promotional incentives or by coming up with new products to tempt consumers. Nevertheless, consumers are being overwhelmed by too many choices as they battle through daily dilemmas of what to wear, eat, buy or watch among thousands and hundreds of products or services available to them.

Consumer package goods manufacturers have fallen into a predictable pattern of new product introduction as more and more products have become stagnated. Year 2002 had just proved to be a banner year of new product introductions, with the number of new product launched exceeding 22,000, the most ever since 1995. The figure is an increase of 15% over year 2001, according to Mint*e*l's global new product database[1].

Once a product has been introduced and then, usually within a short period of time, product line additions begin. The new line items might be variations of size or flavor, or it may be a true extension into a different form of product. From a manufacturer's standpoint, such extensions are a useful tool for keeping brands vital. New variants give substance to advertising and, in theory, bring consumers back to the shelves with renewed interest, which, in turn, generate more sales. However, from a retailer's standpoint, its goal is to carry only

[1] Established in 1972, Mint*e*l International Group Ltd. (Mint*e*l) is well known for providing expert analysis on all aspects of consumers' economic activity and accurate monitoring of global fast-moving consumer goods

the consumer desirable products that keep inventory turns closer to optimal levels and

contribute positive operating profits; as a new product comes in, quite often the slowly

moving items are de-listed and the store continues its evolution.

The unleashing of new product development (NPD) and brand / product line extensions

have led to the proliferation of product choices, which clutters up the supply chain and drives

up the inventory carrying costs. Despite the competition and confusion derived by the

proliferation, however, when it comes to the bottom line - too many choices are chasing too

few consumer dollars, marketers have to call for product deletion (also called elimination,

pruning, or obsoleting) (Vyas, 1993).

1.1 Research Background

The answer to the product proliferation problem seems to narrow down the product

offerings to just a few. After all, manufactures frequently hear the "80/20 rule" meaning that

80% of the sales comes from 20% of the products (Kratchman, Hise, and Ulrich, 1975; Hise,

Parasuraman, and Viswanathan, 1984). However, the real answer is not that simple. If not

managed carefully, the same steps that may help to simplify the complexity of product range

could conversely offset the associated benefits because of reduction in revenue (Hammelman

and Mazze, 1972). On the other hand, an experimental study by Drèze, Hoch, and Purk

(1994) proves that, if conducted properly, deleting 10% of the less popular products and

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(FMCG) industry activity. The global new product database (gnpd) is a comprehensive database that monitors
worldwide product innovation in consumer packaged goods markets.

dedicating more shelf space to fast-selling items may increase aggregate sales up nearly 4% in eight test categories.

Previous research (e.g., Broniarczyk, Hoyer, and McAlister, 1998) found that reductions (up to 54%) in the number of low-selling products may not affect perceptions of variety and, therefore, of sales significantly. Boatwright and Nunes (2001) analyzed data across 42 categories from a natural experiment conducted by an online grocer and found that after the elimination of low-selling products, sales were indeed affected dramatically, increasing an average of 11%. Manufacturers and retailers have started to realize the importance of efficient product assortment, but the unsolved managerial challenge is how to properly identify which product(s) to be deleted from the product range without losing operating profits.

The highly misused, still the most common method for identifying the product to discontinue, is the use of a 'Sales Ranking' report specific to each individual stock keeping unit (SKU). This report, which may be called under many names, is essentially a listing of sales for a fixed duration in which each item is rank-ordered by its sales, revenue, profits, or occasionally, direct product profitability (DPP)[2], and economic value added (EVA)[3].

However, there are two main fallacies in the above-mentioned ranking approach. First, it assumes all products are equally available to be ranked. While this is true at the individual store level (Borin and Ferris, 1990), it is less common at the channel category level (e.g., Key

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[2] DPP is an accounting mechanism popularized in the grocery industry to better allocate direct overhead costs.

[3] Economic Value Added (EVA) is the most prominent version of economic profit or residual income and is defined as follows: EVA = Net Operating Profit After Tax – Capital Employed x Cost of Capital

Accounts, Distributors, etc.) and even less likely at the overall market level. Because a particular product may be very strong in one channel where it is available, it may become insignificant when mixed its sales in that particular channel with the overall sales from other channels. The second fallacy is that ranking reports assume equal product desirability across consumers despite different product characteristics. Hence, the worst selling products represent the least desirable and, thus, should be discontinued. Yet, we know that not all products are equally wanted by all consumers.

Many companies turn to traditional cost accounting methods as a way out of this product deletion identification dilemma. The underlying theory is that, by understanding true product costs for each individual item, the marginal profitability for each product can be calculated as a measure of its contribution (Dudick, 1989). Traditional cost accounting indeed allocates indirect costs to products in an effort to derive their true costs of manufacture and support. However, lacking the ability to tie overheads directly, the method often falls short (Lessner, 1991). The method typically relies on metrics, such as labor or equipment hours, associated with the product volume as the basis for this allocation. These allocations, while common in practice, may oversimplify the product-cost relationship, distorting actual costs, and obscuring product specific decision-making, thus making the approach far less ideal (Ittner, Lanen, and Larcker, 2002).

Alternatively, the Activity Based Costing (ABC) technique matches indirect costs and overhead to products directly, which overcomes indirect costs allocation issues at the expense of putting extra efforts on additional data collection and analysis. In cases when traditional cost accounting cannot be relied upon to represent the actual product costs, ABC

is usually a more reliable technique (Ittner, Lanen, and Larcker, 2002). Conversely, the complication faced by all ABC methods is the added costs and complexities required to extract and maintain the essential cost-related data, which is not necessary the trivial issue in today's dynamic, networked production environment.

Nevertheless, in spite of available financial data (e.g., 80/20 rule, sales, costs, DPP, EVA, ABC), how do managers incorporate other 'non-financial' or 'qualitative' judgments (e.g., future market growth potential, complementary or accessory values, product image) into the decisions of product deletion? After all, not all products with worst profitability are the end-of-life or ill-performed products. For example, a newly launched product with great potential could experience certain period of low sales before the consumer become aware of and, eventually, adapt to it.

A review of the past studies reveals that a knowledge gap exists in the area of product deletion. This research is to bridge this gap. A systematic and analytic tool is still yet to be developed to assist practitioners in facilitating the product deletion decision-making. Researchers (e.g., Alexander, 1964; Eckles, 1971; Avlonitis, 1980; Hart, 1988) have called attention to the subject of product deletion, which is often neglected by managers and academic alike. Undoubtedly, product deletion is an important product management activity, since renewal of a firm's product offerings requires not only the addition and modification of existing product lines, but also the elimination of products that no longer contributing benefits to the firms.

1.2 Objectives of the Research

Despite a flurry of attention during the early 1980s and occasional studies thereafter, product deletion remains an under-explored, yet important, research stream in the business world, given its role in aiding the processes of innovative changes that are central to competitive survival. The objectives of the research are: (1) to gain insights into the evaluation of product performance at the SKU level, and (2) to develop a systematic and analytic tool that helps to quantify the managerial judgments for identifying the product deletion candidates.

It should be pointed out, however, that the emphasis of this research is on merely identifying the product deletion candidates only. The numbers of product to be deleted, the impacts of product deletion, and the actual execution of deletion are not the concerns of the study. The primary attempt here is to put forward some empirical evidence that illustrates the inadequacy of existing knowledge and theory in systematic reviews the measurement of product performance. The study is to provide an understanding of managerial behavior in product deletion and to suggest directions for future research efforts so that academics may develop a useful body of product deletion theory.

1.3 Organization of the Thesis

This thesis is organizing as follows. Chapter 1 starts with an introduction to the phenomenon of overwhelming product choices facing today's consumers. Manufacturers seem to focus on creating excitements by introducing new items with a view to generating more profits. However, what is left unanswered is how to properly identify and retire the obsolete or ill-performed items, which are actually undermining profits. Neither the

academic nor the business world has yet developed a systematic and analytic approach that can take both financial and non-financial factors into account and quantify these factors for identifying product deletion candidates.

Chapter 2 concerns the review on the relevant literature. It first shows why and how product proliferation has prevailed for the past decades, particularly in the consumer packaged goods market. It also addresses that the damaging consequences of product proliferation may incur if the issue is left unattended. Next, the review focuses on relevant issues such as the decision-making process of product deletion, the causes of product deletion, and the alternatives to product deletion, and so on. Last, a summary of what the researchers have documented in the areas of identification of deletion candidates, analyzing for possible revitalization, and evaluating the impacts of product deletion. This chapter concludes with a discussion of the 'death spiral' of product deletion.

Chapter 3 explains what 'Analytic Hierarchy Process' (AHP) is and why it is proposed in this study as a way to identify product deletion candidates. Supported by a practical case study, the research illustrates how AHP can be beneficial in quantifying both financial and non-financial product performance rankings for managers' easier understanding and higher transparency of product deletion decision-making.

Chapter 4 demonstrates and analyzes the empirical results obtained from synthesizing the AHP model, in accordance with the subject company's managerial deliberation. Also covered in this chapter is the discussion of research findings and derived thoughts that have come to light during the data analysis process.

Chapter 5 concludes that AHP proves to be a sophisticated and useful management science tool in identifying product deletion candidates. The chapter summarizes key findings and discusses the implications for both theoretical and managerial fields. In the end, directions for future research are proposed given the knowledge and findings generated from the research.

Chapter 2
Literature Review

Over the past decades, excess production capacity, rapidly changing technology, and higher consumer expectation have led to the proliferation of products to fill machine time and generate greater sales volume growth. Product proliferation inevitably causes consumer's confusion from over-choice (Sproles, 1986), which can result in potential misuse of a product and lead to consumer dissatisfaction, lower repeat sales, more returned products, reduced customer loyalty, and poorer brand image (Mitchell and Papavassiliou, 1999). It is therefore vital for companies to have a clear idea of what induces the proliferation of product and of how to clearly identify and aggressively retire the products that no longer fit the strategic objectives of the firm.

2.1 Products Proliferation

During the 1980s, brand / product line extensions became popular as new product and new brand introductions had become cost prohibitive (Tauber, 1988). Firms used brands as a leverage to minimize the costs associated with the introduction of new products (Hardle and Lodish, 1994; Smith, 1992). Prior research suggests that a product extension can derive positive externalities from a high equity parent brand (Reddy, Holak, and Bhat, 1994; Smith and Park, 1992). Empirical studies have also found positive contributions of variety to market shares of multi-product firms (Bayus and Putsis 1999; Kekre and Srinivasan 1990). Accordingly, products have proliferated at an unprecedented rate in most categories of consumer goods and services (Quelch and Kenny, 1994).

Bayus and Putsis (1999) summarize three primary effects of a product proliferation strategy: (1) a broad product line can increase the overall demand faced by the firm, (2) a broad product line can affect supply by increasing costs, and (3) broad product lines can have strategic consequences (e.g., long product lines can deter entry, thereby allowing an incumbent firm to raise prices). Nevertheless, they also suggest that product proliferation can be a doubled-edged strategy. A firm with a long product line may be able to obtain a high market share, but it can also end up with higher prices due to the higher costs of managing the broad product line.

Aaker (1991) reported that 89% of all new products are line extensions, 6% are brand extensions and only 5% involves a new brand name. Line extensions are by far the most popular way of introducing new products (Green and Krieger, 1987). Despite the prevalence of line extensions, past experience has given companies awareness of line extensions' possibilities and limitations (Nijssen, 1999). Today brand leverage is considered a facilitator of new product success rather than merely a way to cut advertising expenditure (Yentis and Bond, 1995). Managers are now more concerned with brand dilution and likely loss of brand equity incurred by failed extensions (Loken and John, 1993).

2.1.1 Potential Pitfalls of Product Proliferation

With respect to manufacturing and operating costs, prevailing product proliferation may reduce economies of scale in production and lead to frequent setups and short production runs, which drives up manufacturing costs. Product proliferation can also cause difficulties in forecasting sales volumes, and thus increase the complexity of production scheduling.

Unfortunately, manufacturers commonly react to such complexity by creating excessive safety stock, driven by uncertainty in demand, which leads to higher inventory carrying cost (Cook, 2001).

From the perspective of marketing, product proliferation may also reduce the effectiveness of marketing and distribution strategies (Wind, 1982). Product proliferation may weaken the line logic, which refers to a salesperson's ability to explain to the customer the strategic significance of one SKU offering versus another within a brand (Quelch and Kenny, 1994). Product proliferation may also lead to lower brand loyalty, a deterioration of brand image and lost sales (Quelch and Kenny, 1994; Mitchell and Papavassiliou, 1997). As each time a new product is introduced, it disrupts the consumer's buying pattern. It allows the consumer to be aware of the new choice as well as competitive choices. At the same time, competitors can answer the product change with new products in their line-up. Again, this invites the consumer to choose the competitors' products in the next purchase cycle.

By bringing important new products to market as line extensions may sometimes under exploit good ideas (Quelch and Kenny, 1994). Some product ideas are big enough to warrant a new product. When pushing a new product with only minor change into the marketplace as a line extension, manufacturers potentially miss the opportunity to develop the good idea into a new product category.

Product proliferation is disturbing trade relations as well. Usually, line extensions rarely expand total category demand. People do not eat or drink more, wash their hair more, or brush their teeth more frequently simply because they have more products to choose. So the

stagnant category demand has forced retailers to respond to the proliferation by rationing their shelf space, stocking slowly-moving items only during promotion and charging manufacturers with slotting fees that cover shelf space for new items or with failure fees for items fail to meet sales target within two or three months of try-out period (Quench and Kenny, 1994).

2.1.2 Effects of Cannibalization

Ideally the additional sales from new product offerings would be derived from the incremental revenues as a result of market expansion or consumer switching from competitors' brands, or a combination of the two. Nevertheless, another consequence is that new products may gain their shares from their existing product portfolios. The work of Ehrenberg (1988) suggests that any new product entering a market will take share from all the existing players in proportion to their sizes. Manufacturers use existing brand names to reduce barriers to entry for new products with the implicit assumption that additional profit will be earned as a result. But haunting the parent brand is the specter of cannibalization. What if the line extension will be successful but only at the expense of the parent? It seems possible that additional costs will be incurred without the benefit of incremental revenue (Lomax, Hammond, East, and Clemente, 1997).

Despite no generally accepted definition of cannibalization, Heskett (1976) defines it as 'the process by which a new product gains sales by diverting them from an existing product.' Copulsky's (1976) definition is less concerned with process than with magnitude. He defines

cannibalization as 'the extent to which one product's customers are at the expense of other products offered by the same firm.'

Cannibalization is a very real threat for the vast majority of new product introductions, while it is, however, difficult to determine or measure the effects of cannibalization (Mason and Milne, 1994). Practitioners tend to take a more aggregate approach and focus on sales volumes and shares, not on individual consumer's buying patterns, which may oversimplify the measurement problem. A valid measure might be the percentage of the new product's sales that derives from the sales of an existing product within the company's portfolio (Reddy, Holak, and Bhat, 1994).

Cannibalization can result in additional costs without the benefit of incremental revenue. Specifically, sales volume tends to be reduced for each brand with increasing manufacturing complexity and increased inventory, more management resources required, more advertising (or less per brand), clutter and confusion in advertising for both customers and distributors. Yet it is difficult for any manufacturer to evaluate the cannibalization effects (Lomax, Hammond, East, and Clemente, 1997).

2.1.3 Emergence of Category Management

In the middle of 1990s, the uncontainable product proliferation has brought the consumer to the over-excitements of emerging new products and eroded the competitiveness of many traditional retailers (Zenor and Zerrillo, 1995). To cope with this challenge, retailers and suppliers have responded with so-called "Category Management," which focuses on creating varieties, not duplications, to minimize the proliferation-derived confusion and complexity

for consumers, manufacturers, and retailers. Increasing powerful retailers emphasize category management and seek to develop closer relationships with suppliers that are willing to organize their product lines to maximize their and retailers' profitability (Quelch and Kenny, 1994).

The concept of category management states that retailers and suppliers work together for mutual benefit. Earlier recommendations of arm's length relationships to suppliers have been replaced by an emphasis on the benefits that can be reaped from close relationships (Gadde and Snehota 2000; Carlisle and Parker 1989). The emphasis herein is 'working together' between retailers and suppliers to realize the delivery of consumer value.

At the core of category management concept is the focus on a better understanding of consumer needs as the basis for retailers' and suppliers' strategies, goals and work processes, especially in four main areas including establishing infrastructure, optimizing product introduction, promotion and product assortment (ECR Europe[4], 1997). This approach contrasts sharply with the traditional product management strategy wherein dedicated managers are charged with the responsibility of maximizing returns from individual products (Zenor and Zerrillo, 1995).

From the suppliers' viewpoint, low-selling products create fragmentation of the sales and marketing efforts, dilution of the brand image, and greater difficulty in forecasting demand. Category management provides both retailers and suppliers with opportunities to proactively

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[4] ECR (Efficient Consumer Response) Europe is a joint trade and industry body, launched in 1994 to make the grocery sector as a whole more responsive to consumer demand and promote the removal of unnecessary costs from the supply chain.

manage products that may be eliminated through competitive activities, retail decisions, and changing consumer preferences. Rather than confusing the consumers with over-choice that caused by product proliferation, the reduction of product assortment allows consumers to understand their choices better within the line-up of standardized product categories (Steinby, 2002).

2.2 Product Deletion

Most of earlier studies on product deletion either explicitly or implicitly assume that product deletion is an essential strategy for mature products. However, a decline in sales does not necessarily mean that the product has left or is about to leave its maturity stage (Day, 1981; Ayres and Steger, 1985). Avlonitis (1990) indicates that 'the association of the product elimination decision with the decline stage of the PLC is misleading.' The classic PLC charts the product life progress in the absence of managerial intervention; however, in practices, management will take numerous measures to prolong the life of the products. Products may also be deleted irrespective of their position on the PLC. For instance, 'new product failures,' in a sense, represents product deletion decisions in the early stage of the PLC.

2.2.1 Decision-Making of Product Deletion

A review of the literature reveals that product deletion involves a multi-staged process. Alexander (1964) probes product elimination using a three-phased process: (1) selection of elimination candidates, (2) analysis and decision making about the candidates, and (3) implementation of decision. Kotler (1965) echoes Alexander's view of the elimination
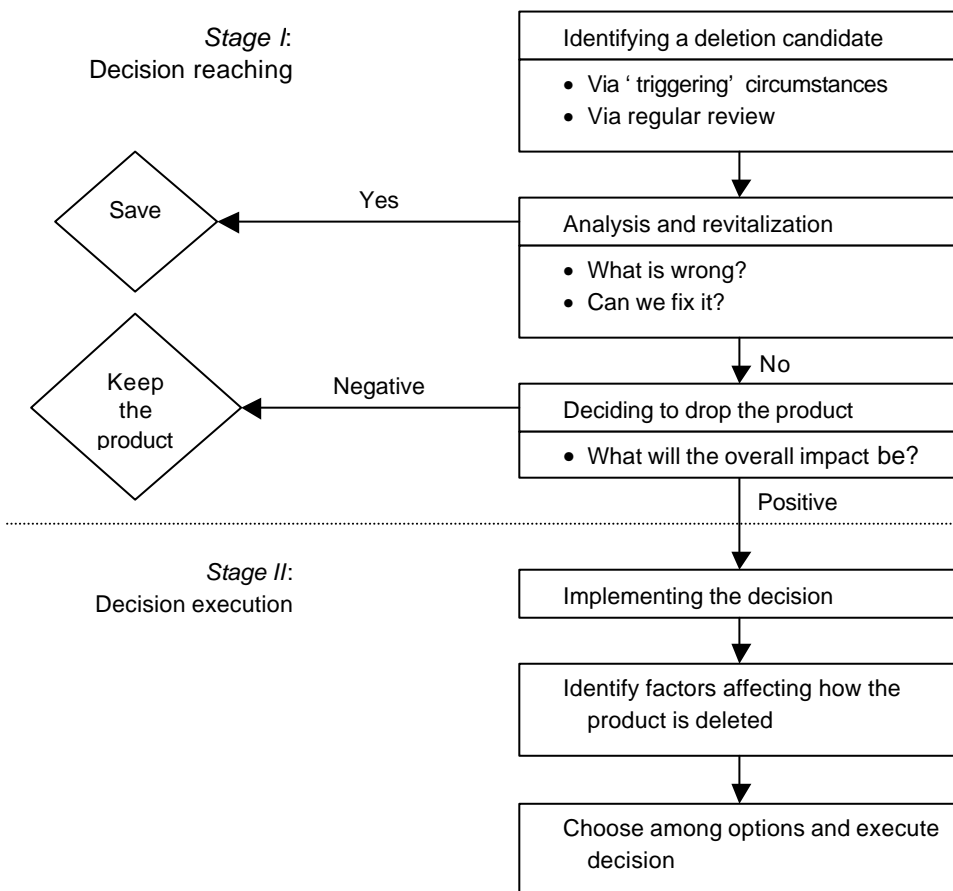
process as multi-staged and sequential, comprising recognition, evolution and decision-making and implementation stages. He conceives a two-phased procedure to make the decisions: a 'creation' phase and an 'operational' phase. Avlonitis (1980) proposes a comprehensive framework for the product deletion process based on both Alexander and Kotler's works and an empirical study of industrial goods firms. In his framework, phases already described by Alexander and Kotler are re-addressed, such as 'audit (review) of the product line', 'diagnosis', 'decision-making' and 'implementation.' In addition, he shows some subroutines within each phase as well as possible impacts of organizational factors and the information-gathering procedures on the whole process.

With the groundwork laid by the aforementioned research, Hart (1987) conducted an empirical cross-sectional study on British manufacturing goods, developing a model as shown in Figure 2-1 for understanding and examining product deletion decisions in a more practical approach. The resulting model builds on the simplified view of Kotler (1965), which expresses that the scope of product deletion consists of two major stages: a 'decision-reaching' stage and a 'decision-implementation' stage.

In the 'decision-reaching' stage of Hart's (1987) model of product deletion decision-making, the deletion candidates are first identified either via the causes for product deletion (which will be covered in section 2.2.2) or via regular product performance review. The deletion candidates are then analyzed to see if there is any other alternative (which will be covered in section 2.2.3) can be done besides deletion; if not, what will the overall impact be? Once the deletion candidates have gone through this 'decision-reaching' stage and the deletion decision has been reached, the next stage is the 'decision-implementation,' which

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focuses on identifying factors affecting and developing strategies on 'when' and 'how' to

retire products with minimum impacts to consumers, retailers and manufacturers themselves.

Figure 2-1.
Schematic Overview of Hart's Product Deletion Decision-making Model

Stage I:
Decision reaching

| Identifying a deletion candidate |
| • Via 'triggering' circumstances |
| • Via regular review |

Save — Yes

| Analysis and revitalization |
| • What is wrong? |
| • Can we fix it? |

No

Keep the product — Negative

| Deciding to drop the product |
| • What will the overall impact be? |

Positive

Stage II:
Decision execution

| Implementing the decision |

| Identify factors affecting how the product is deleted |

| Choose among options and execute decision |

Source: Hart, S.J. (1987), "An exploratory investigation of the product elimination decision in British manufacturing industry", Unpublished PhD thesis, University of Strathclyde.

2.2.2 The Causes for Product Deletion

In addition to a number of refinements to the product deletion decision-making process, Hart's (1987) product deletion decision-making model differs from early works in the identification of a set of seventeen 'precipitating circumstances' that 'trigger' product deletion, which are based on Avlonitis and James' (1982) eight 'basic problem situations'. For detailed comparison, Table 2-1 summarizes the antecedents for product deletion from the two studies.

In Avlonitis and James' (1982) study, they found that the eight basic problem situations identified are indicative of the character and mix of the conditions under which a product may be deleted. They also highlighted the fact that management of a company is not always 'independent' in making the product deletion decision. There are situations under which management has little or no control of the subject matter or the scheduling of the deletion process. For instance, the problem situations 1, 2, and 4 represent the problems beyond the control of management in terms of content (i.e., the type of product affected) and timing (i.e., when will they happen). These problems are often accompanied by severe limitations with respect to time in which management has to define and choose its action. In contrast, the problem situations 6, 7, and 8 are created, to a large extent, by management itself as part of the company's product planning process and usually lead to the elimination of products under the management's control. These problems typically require a lower level of urgency with which they must be resolved.

Hart's (1987) seventeen precipitating circumstances, which are further classified into four categories: (1) poor performance triggers, due to the product itself that has fail to deliver the

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expected results, (2) strategic triggers, led by the other strategic concerns that need to

discontinue the product, (3) operational triggers, caused by difficulties in producing the

product, and (4) external triggers, covering a broader scope by bringing in the concepts of

'competitors' and the 'exchange rates' factors for emerging international business nowadays.

The circumstances reflect a broader variety of reasons why a product might be removed from

the range and it does not always relate to poor product performance. This finding suggests

that some deletion decisions are taken in a planned, not a 'crisis,' manner. For example, the

initiation of a policy of variety reduction or deletion caused by the transfer of resources

represents decisions that are forward looking and progressive, rather than reactionary and

retrograde (Hart, 1987).

Table 2-1.

The Causes for Product Deletion

Avlonitis and James' Eight basic problem situations	Hart's seventeen precipitating circumstances

1. Government policies and regulations
2. Changes in the third party specifications
3. Decline in market potential
4. Parent organization decisions and policies
5. Poor product performance (despite a generally viable market)
6. Development of new products
7. Rationalization brought by mergers and acquisitions
8. Development of an active variety reduction policy
	• **Poor performance triggers**
	  1. Decline in market potential
	  2. Poor sales performance despite a generally viable market
	  3. Poor profit performance
	  4. Poor product quality
	• **Strategic triggers**
	  5. Resources required elsewhere
	  6. Development of an active variety reduction (rationalization)
	  7. Poor fit with strategic plans and company capabilities
	  8. Rationalization due to mergers and acquisitions

	9. Poor fit with company image
	10. Parent company decisions and policies
	11. The development of a new product
	• **Operational triggers**
	12. Problems associated with raw material and parts
	13. Operational problems
	• **External triggers**
	14. Competitive activity
	15. Third-party decisions
	16. Government policies and regulations
	17. A change in exchange rates

Sources:

- Avlonitis, G.J. and James, B.G.S. (1982), "Some dangerous axioms of product elimination decision-making", *European Journal of Marketing*, Vol. 16, No. 1, pp. 38.
- Hart, S.J. (1987), "An exploratory investigation of the product elimination decision in British manufacturing industry", Unpublished PhD thesis, University of Strathclyde.

2.2.3 Alternatives to Product Deletion

Previous research (Day, 1981; Ayres and Steger, 1985) has proved that not all products with low profitability and declining sales ought to be deleted, nor are those with low profitability and declining sales (Avlonitis and James, 1982). As a matter of fact, another research has indicated that product deletion is a managerial decision that is often avoided The reason for avoiding product deletion is that the situation may be "savable" (Hart, 1988), and the product could be revitalized in several ways (Ayres and Steger, 1985; Avlonitis, 1985). This implies that the first managerial action should be to investigate the causes of the problems and see if it can be solved.

The research by Lambert (1988) indicates some of the strategies could be considered as alternatives to product deletion. Baker and Hart (1999) elaborate and organize them under the aide-memory of the four P's (i.e., price, product, promotion, and place) scheme as shown in Table 2-2. Basically, the alternatives represent, in essence, the efforts to find out what aspects of the four P's result in the products' poor performance and, accordingly, make adjustments.

Table 2-2.
Alternatives to Product Deletion

Price-related methods	Promotion-related methods
• Decrease price	• Increase sales fore efforts
• Increase price	• Increase sales promotion
• Product efficiency improvement	• Increase advertising
• Cost reduction	**Distribution-related methods**
Product-related methods	• Distribution improvement
• Product modification	• Change channels of distribution
• Quality improvement	**Marketing-strategy methods**
• Product range extension	• Extend product to new market
• Product range reduction	• Withdraw product from some markets
• Extension of warranties	• Factor or source
• Packaging changes	

Source: Baker, M.J. and Hart, S.J. (1999), *Product strategy and management.* Prentice Hall Europe, pp. 445.

However, the basic errors that can make these alternatives ineffective, which lead to a procrastinating or reluctant approach in product deletion, are: (1) the failure to establish a definite written procedure that facilitates proactively managerial actions in reviewing products' performance and deleting weakly performed products (Eckles, 1971); (2) the

failure to set a reasonable time interval for revitalizing actions reviewing, which is why the alternatives are often used as 'contingencies' for managers to buy some more time before the products eventually are being sentenced for death (Avlonitis, 1985). This is also why monitoring the causes of product deletion should be regulated as an on-going activity (Harness, Marr, and Goy, 1998).

2.3 Reaching the Decision on Product Deletion

Deletion of a product is not a decision reached easily. Once the deletion candidates are identified, it involves a good deal of analysis for possible revitalization, evaluation for deletion impact, and deliberation among all functional departments. All these steps are needed to fine filter the list of deletion candidates and separated those into two target groups: ones for possible revitalization and the others need to be deleted immediately as they truly no longer contribute in a satisfactory way to the firm.

2.3.1 Identification of Deletion Candidates

Many of earlier studies on identification of deletion candidates had focused on reviewing criteria that are relevant considerations to permit the computation of an 'index' number indicating the degree of product desirability (Kotler, 1965; Berenson, 1963; Worthing, 1971; Hammelman and Mazze, 1972). Kratchman, Hise, and Ulrich (1975) put together a summary of warning 'signals', transformed and manipulated from the basic accounting data, to alert the management that a product maybe in trouble.

However, besides financial factors, non-financial factors could be crucial in evaluating individual product's business contribution, too. As Eckles (1971) suggests "a deletion

decision may affect several functional groups within a firm: marketing, production, finance, and some time personnel." And the evaluation factors should covers both internal (i.e., within the organization) and external (i.e., consumers, customers, and competitors) ones. A survey performed by Hise and McGinnis (1975) also suggests that external factors, besides internal factors, need to be taken into consideration. For example, external factors may include effects on consumers or customers and competitors' activities.

Banville and Pletcher (1974) identify a set of twenty-six variables influencing the product deletion and categorize the variables into seven 'variable subsets' includes: sales, profit, administration, production, distribution, market advantage, and externalities. Consequently, Baker and Hart (1999) categorize the review criteria for identifying deletion candidates as summarized in Table 2-3.

The review criteria consist of four categories including: (1) sales-related criteria, which are used to judge whether the deletion candidates' past, current, and future cash flow contribution, (2) market-related criteria, which determine whether the proper strategies and resources have been utilized and allocated for the deletion candidates, (3) profit-related criteria, which tell how much operating profits the deletion candidates can generate, and (4) operating criteria, which concern to what extent the deletion candidates require supports and resources.

Baker and Hart's (1999) criteria may lead to managerial problems associated with data collection. The financial factors (i.e., most of the sales-related, profit-related, and operating related ones in Table 2-3) may be collected via the internal accounting (e.g., invoicing,

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costing, inventory, etc.) systems that are typically computerized and broken down by product category, product line, or even individual SKU. However, the non-financial factors (i.e., market-related ones) are usually hard to obtained and quantified into the product performance review. Although data like market share may be purchased from market information providers like AC Nielsen, the numbers are usually calculated at brand / product line level and rarely at the individual SKU level.

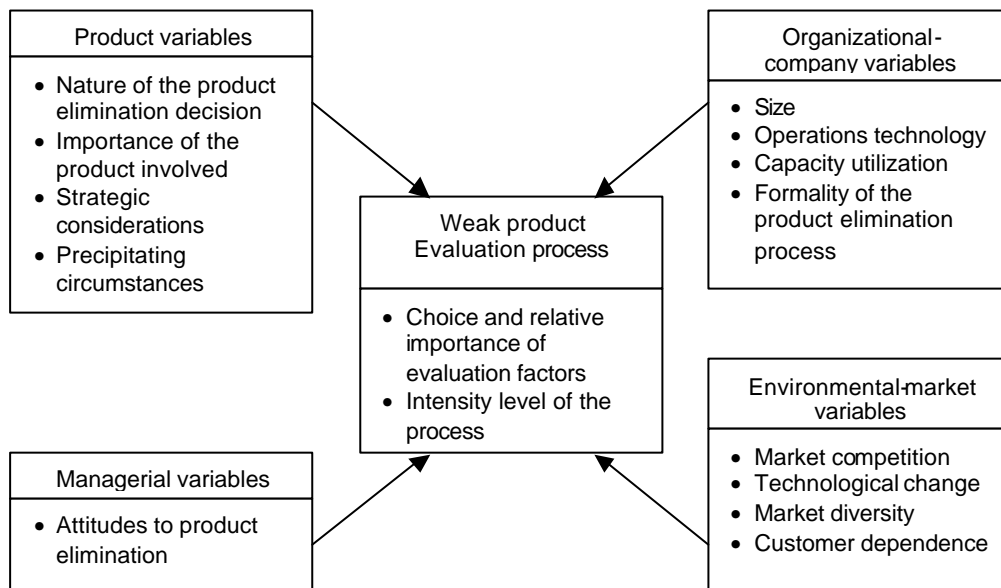**Table 2-3.**
Review Criteria for Identifying Deletion Candidates

Sales-related criteria	Profit-related criteria
- Past sale volume - The product's percentage of overall company sales - Future sales volume	- The product's profit contribution - Price trends - Sales generated versus resources used in generating sales
Market-related criteria	**Operating criteria**
- Market growth - Market share - The stage of the product on its PLC curve - Customer acceptance of the product - Competitive activity in the marketplace	- Stock inventory levels - Service levels - Batch sizes - Operational problems

Source: Baker, M.J. and Hart, S.J. (1999), *Product strategy and management.* Prentice Hall Europe, pp. 439.

In addition to the aforementioned review criteria, Avlonitis (1993) argued that the evaluation factors used by management vary with product, company, organizational and environmental conditions. According to his earlier research (1982, 1984, 1985), the choice and relative importance of the evaluation factors tend to vary in relation to certain contextual conditions, including product diversity, operations technology, market competition, and

technological change. These thoughts are then further fine-tuned in his study (1993) and

presented in Figure 2-2.

Figure 2-2.
Framework of Avlonitis's Weak Product Evaluation Process

Product variables	Weak product Evaluation process	Organizational- company variables
• Nature of the product elimination decision • Importance of the product involved • Strategic considerations • Precipitating circumstances	• Choice and relative importance of evaluation factors • Intensity level of the process	• Size • Operations technology • Capacity utilization • Formality of the product elimination process
Managerial variables • Attitudes to product elimination		**Environmental-market variables** • Market competition • Technological change • Market diversity • Customer dependence

Source: Avlonitis, G.J. (1993), "Project dropstat: what factors do managers consider in deciding whether to drop a project?", *European Journal of Marketing,* Vol. 27, pp. 37.

Unlike previous work, Avlonitis (1993) combines the aforementioned 'objective' product

performance evaluation factors and the 'subjective' conditions, including: product conditions,

managerial conditions, company conditions, and market conditions, for a more

comprehensive and thorough investigation of the contextual framework for weak product

performance evaluation.

The underlying theory here is that the evaluation process is determined by specific product, organizational, managerial, and environmental conditions. It also implies that the search for the 'golden,' 'general purpose' product deletion model should be replaced with a search designed to uncover the product deletion process as it is being conducted by management in particular managerial and organizational settings and for particular product circumstances.

2.3.2 Analysis for Possible Revitalization

After the candidates for deletion are identified, the management usually analyzes what is initially wrong with the product and determines whether the product can be revitalized in some ways (Ayres and Steger, 1985; Avlonitis, 1985; Hart, 1988), so it will not be accidentally sentenced to death. The key question, however, is how costly are such efforts and how profitable will they be (Aaker, 1984; Zeithaml, 1988). And the revitalizing strategy might differ by products with differing levels of market share and resources required (Wansink and Huffman, 2001).

Although the launch and deletion of products are normally separated by academics, product revitalization provides the link between these two decisions in that they should be synchronized together (Saunders and Jobber, 1994). As a matter of fact, it was observed that the majority of produce management decisions are product replacement decisions, instead of product deletion decisions (Vyas, 1993).

Baker and Hart (1999) suggested two main analyses: (1) profit-related analysis, which exams on both sides (i.e., costs incurred and prices charged) of the profit equation to investigate any abnormal situations that can cause profit-losing, and (2) sales-related analysis,

which focuses on both internal (i.e., sales efforts, product availability, etc.) and external aspects (i.e., the firm's approach to the customers, the competition in general, and their product services and prices, etc.). The details are summarized in Table 2-4. These analyses provide the chance to re-exam the reasons for ill performance and for possible revitalization.

Table 2-4.
Analytic Methods for Possible Revitalization

Profit-related analyses	Sales-related analyses
• Cost of ingredients or parts	*Internal focus*
• Efficiency of the manufacturing lines	• Sales force activity
• Raw material/parts stock holding	• Availability of the product to the customer
• Variance in materials usage	• Regional sales comparison
• Price levels	• The product's position on its life cycle curve
• Mix of sales across the product range	• Lost order analysis
	External focus
	• Test market approach
	• Competitive activity
	• Level of distributive trade support
	• Analysis of market dynamics and trends

Source: Baker, M.J. and Hart, S.J. (1999), *Product strategy and management.* Prentice Hall Europe, pp. 443.

2.3.3 Evaluate the Impacts of Product Deletion

When a product has been revitalized without much success, or when the management believes that no corrective action is feasible and concludes no justification for improvement, the next managerial action is to evaluate whether deletion of the product is an appropriate course of action. Despite the neat and objective solutions forwarded by some of the theoretical contributions to the literature (Alexander, 1964; Kotler, 1965; Hamelman and

Mazze, 1972), empirical work (Avlonitis, 1984; Hart, 1989) would suggest that the evaluation stage is the most perplexing one. It is at this stage a decision must be finally taken, with or without adequate knowledge, and the decision is usually complicated by uncertainty and risk.

Researchers (Avlonitis, 1984; Hart, 1989; Baker and Hart, 1999) have help identified a wide variety of factors, both internal and external, relevant to the evaluation, which are listed in Table 2-5. Internal factors include those which focus managerial attention on what might happen to resources in the event of a deletion as well as the direct financial implication of such a deletion, while the external factors focus on minimizing the negative impact caused on both consumers and customers.

Table 2-5.
Evaluation Factors for the Impact of Product Deletion

Internal evaluation factors	External evaluation factors
Resource-related	• Product's market potential
• Availability of a new product	• Effect of the deletion on distribution (e.g., loss of shelf space)
• Effect of the elimination on recovery of overheads	• Effect of the deletion on 'full range' policy
• Reallocation of resources to other opportunities	• Existence of substitutes to satisfy the customer
• Effect of the deletion on fixed capital (i.e., plant and equipment)	• Effect of the deletion on company image
• Interchangeability (communization) of parts, materials or packing	• Competitive reaction to the withdrawal
• Effect of the deletion on capacity utilization	• Customer relations
• Reallocation of executive and selling time	
• Effect of the deletion on working capital (e.g. stock)	
• Effect of the deletion on employment prospects of the workforce	

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Finance-related • Effect of the deletion on total company sales volume • Effect of the deletion on sales and profitability of other products in the range • Product's contribution to a profit center (e.g., branch, factory, depot.)	

Source: Baker, M.J. and Hart, S.J. (1999), *Product strategy and management.* Prentice Hall Europe, pp. 448.

2.3.4 The 'Death Spiral' of Product Deletion

What needs to be reminded and emphasized in the understanding of product deletion is the "death spiral" of product deletion. When prices drop and revenues are constrained, the response is to manage costs in the interest of assuring products' profitability. But, unlike revenues, costs pose a very different analytic platform. Often, the failure to understand cost structure and behavior fundamental to a firm's strategic architecture is the primary reason why product elimination poses the risk of what managerial economists refer to as the "death spiral".

As perfectly described by Pastore (2000), 'the death spiral result from a failure to understand how volume dependent costs (i.e., variable costs) and volume independent costs (i.e., fixed costs) impact judgment about the wisdom of continuing or discontinuing a product.' Radhakakrishnan and Srinidhi (1997) comment that product deletion occurs due to products are going into a "death spiral" because cost data is incorrectly used, incurring early product discontinuance.

The death spiral response is neither merely academic nor metaphorically poetic. Products generate revenue and variable costs and the relationship between each other determines positive or negative cash flow. Cash flow supports a firm's ability to cover fixed costs and beyond that to contribute to overall profitability. A decision to eliminate one product with worse profitability increase the shared loads of the remaining products for fixed costs, which may generate a chain reaction to delete more products and, subsequently, result in much greater cost-sharing burden of the product left. Such a vicious cycle, in a sense, becomes the death spiral (Pastore, 2000).

Chapter 3
Research Methodology

The product deletion process involves ranking several candidates according to their relative performance in various attributes, which, in essence, is a multiple criteria decision-making (MCDM) situation. The recent study by Parkan and Wu (2000) compares three modern MCDM tools and suggests that Analytic Hierarchy Process (AHP) is preferable by practitioners when direct quantitative information is unavailable. AHP can be used to structure the decision process, obtaining revealed priorities for criteria and any subcriteria and for alternatives at various decision levels by ways of pairwise comparisons. The AHP has been successfully applied to resolve problems in business decisions like prioritizing corporate objectives, buying equipment, assigning management personnel, deciding on inventory levels, getting the best source for borrowing funds, finding markets and determining mergers and acquisitions (Saaty, 1980).

Davies (2001) reviewed an extensive marketing applications using AHP and found that, with the accuracy of knowledge elicitation involved, AHP can fulfill the requirements of a decision support system. AHP has proven to be effective and utilized, in particular, to decide which new products to launch (Calantone, Di Benedetto, and Schmidt, 1999) and evaluate the success likelihood in the current or proposed product development process (Muller, and Fair-Clarke, 2000). The previous studies have inspired the adoption of AHP in this study. It is appropriate to use AHP for identifying product deletion candidates given AHP's ability to handle both qualitative and quantitative factors and sub-factors suits the requirements,

conditions and information availabilities encompassing the identification of product deletion candidates. However, no practitioners or researchers have yet utilized AHP to assist product deletion decisions. Hence, this research represents the first attempt to do so.

3.1 The Analytic Hierarchy Process

The AHP, developed by Satty (1977, 1980), is a multi-criteria decision approach designed to aid in the solution of complex, unstructured, multiple-attribute problems in a number of application domains. The AHP uses a hierarchical model composed of a goal, criteria, perhaps several levels of subcriteria, and alternatives for each problem or decision. It is a general method for structuring intricate or ill-defined problems that is built around three principles:

1. The principle of constructing hierarchies.
2. The principle of establishing priorities.
3. The principle of logical consistency.

The AHP's flexible and efficient hierarchic framework guides the decision makers to the decision of concern. Because all parts of the hierarchy are interrelated, it is easy to see how a change in one factor will affect the other factors. By laying out decisions in this format, the decision makers can easily incorporate many types of data, accommodate differences in various levels of performance, and make trade-offs among things that look different (Lilien and Rangaswamy, 1998).

The backbone of the AHP is actually a set of mathematical formulas in linear algebra and graph theory. It can be manipulated by most of the commonly used spreadsheet software. The easy-to-use commercial software for AHP (i.e., "Expert Choice") is commercially available, which provides a user-friendly interface and helps in reconciling differences (i.e., inconsistencies) in managerial judgments and perceptions.

According to Johnson (1980), the steps of AHP process can be described briefly as the following five steps: (1) the 'decision hierarchy' is developed by asking the respondent to state his/her managerial goals, list all the available choices, and identify all the criteria that will be used to rate the choices. The result is a hierarchical decision tree; (2) comparison data as input is collected for each element of the tree with respect to the next higher level. That is, criteria are compared in terms of their importance in reaching the goals, and alternatives are compared in terms of their preferences on each criterion; (3) the comparison data are converted to relative weights of the decision elements. This is accomplished by solving the eigenvalue[5] problem of the matrix specified in the second step; (4) using hierarchical composition, the weights of the decision elements are aggregated and the composite priorities of each element at each level are obtained; (5) this procedure provides an overall numerical ranking of the available alternatives. Steps three and four are performed by the AHP software using the hierarchical tree structure and paired comparison data

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[5] Eigenvalues are a special set of scalars associated with a linear system of equations (i.e., a matrix equation) that are sometimes also known as characteristic roots, proper values, or latent roots (Marcus and Minc, 1988). Each eigenvalue is paired with a corresponding so-called eigenvector (or, in general, a corresponding right eigenvector and a corresponding left eigenvector; there is no analogous distinction between left and right for eigenvalues).

obtained from the respondent in steps one and two. In essence, AHP requires the "expert" (i.e., the manager) to identify his/her key decision-making criteria and then to assess each available alternative on each criterion by making paired comparisons. Afterwards, the AHP routine combines all the information and rates the alternatives based on the criteria as specified by the respondent.

3.2 The Research Setting

A Taiwanese subsidiary of a major global firm in the manufacturing and marketing of a range of fast-moving consumer goods (FMCG) products agreed to participate in this study. In year 2000, the company has decided to consolidate its operation in Taiwan by integrating two former subsidiaries and become one of the largest FMCG companies in Taiwan.

Following the merger, with a view to reducing costs, increasing efficiency and sales volume, the company immediately faced a main challenge: the two former companies have similar product portfolios in the market where they used to compete with each other, leading inevitably to the need for product rationalization. The most impending task emerged from its inability to eliminate products without jeopardizing its goals that drive for the merger / acquisition action.

The company's revenue is generated from three main segments: approximate 40% from 'Family Care', 35% from 'Personal Care', and 25% from 'Business-to-Business'. Within the three segments, it is further divided down into twelve sectors with more than thirty product groups in total, and each product group could have several product lines. The company has now more than 1,800 SKUs in total.

The company has formed a product-review committee with two important objectives inherent in the committee: (1) to set up a systematic and analytic product performance review approach for identifying and analyzing the weakly performed products for possible deletion[6], and (2) to develop and establish policies and plans for periodic reviewing and phasing out dropped products. The product-review committee is led by the Group Managing Director, and the appointed members include the functional department heads from Finance, Marketing, Operations, Logistics, and Sales, so that each function has the chance to express its concerns in product performance review and take part of the product deletion decision-makings.

The company's condition provides a perfect case study opportunity for the subject of this study. First of all, the company is in the FMCG industry, which is experiencing and suffering the most from product proliferation. The industry should anticipate and benefit the most from product deletion. Secondly, the company is a newly merged company, whose products range has more than 1,800 SKUs, and most of the products are 'duplicated'. Thirdly, and most importantly, a subjective method for identifying product deletion candidates is necessary particularly in the circumstance of the newly merged company. The decision made in this company could be challenged by anyone if they like, and virtually leaves no room for bias.

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[6] Rather then selecting the strongly performed products to keep, the more rational approach is to identify the weakly performed ones to delete, since the product deletion process provides the chances to review the causes and possible solutions in isolating the truly product deletion candidates.

3.3 Structuring the Hierarchy

The simplest form used to structure a decision problem is a hierarchy of three levels: the 'goal' of the decision is at the top, followed by a second level of 'criteria' and a third level of 'alternatives'. Hierarchical decomposition of complex systems is a powerful way to help the mind cope with diversity. The purpose of the structure is to make it possible to judge the importance of the elements on a given level with respect to some or all of the elements on the adjacent level above (Saaty, 1980).

Arranging the goals, attributes, issues, and stakeholders in a hierarchy serves two purposes. It provides an overview of the complex relationships inherent in the situation. It also helps the decision maker to assess whether the issues on each level are of the same order of magnitude, so that he/she can compare such homogeneous elements accurately (Lilien and Rangaswamy, 1998).

What needs to be emphasized, as suggested in the 'Expert Choice' program's (the Program) instruction, is: 'When constructing hierarchies one must include sufficient relevant details to represent the problem as thoroughly as possible, but not so thoroughly as to lose sensitivity of the outcomes to change in the objectives and criteria. Consider the environment surrounding the problem. Identify the issues or attributes that may contribute to the solution. Identify the participants associated with the problem.'

In the case of this study, the product-review committee members were instructed to reference to Baker and Hart's (1999) review criteria (i.e., sales-related, market-related, profit-related, and operating; referring back to Table 2-3) and Avlonitis' (1993) contextual conditions (i.e., product conditions, managerial conditions, company conditions, and market

conditions; referring back to Figure 2-2) for identifying deletion candidates. Modifications

were made to fit the company's specific need to properly represent and cover all areas of

concern into the structure of the hierarchy. The product-review committee members have all

agreed to the 'goal' being set as 'Ranking of the products' business contribution', and each

function attributed for one 'criteria' on the primary level[7] (i.e., 'Fin.Atr.', 'Mkt.Atr.',

'Opt.Atr.', 'Log.Atr.', and 'Sal.Atr.'; see Table 3-1 for definitions of abbreviations used) to

exploit each member's expertise in his/her own functional field. Besides, this approach also

maps with the company's current organization structure.

Heads of each functional department are then responsible for scheming the secondary

'criteria' (i.e., subcriteria) for his/her own area under the primary level. The 'alternatives' in

this case means the deletion candidates selected to undergo this exercise for their

performance ranking; the one with the lowest ranking is considered as the weakest-performed

product, and should be the first one to be considered being deleted among the candidates.

The hierarchy structured by the product-review committee is shown in Figure 3-1.

For Finance department, sales and profits have always been their most concerns, which are

evidenced by the two sub-criteria under the 'Financial Attributes': (1) the deletion

candidate's (the Product) share of the company's total net sales value, which can be used to

tell how much cash flow the Product is bringing into the company, and to avoid the 'death

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[7] More/less criteria could have been used in other situation, depending upon managerial inputs, same for the subcriteria and alternatives.

Figure 3-1.

AHP Decision Tree for Identifying the Product Deletion Candidates
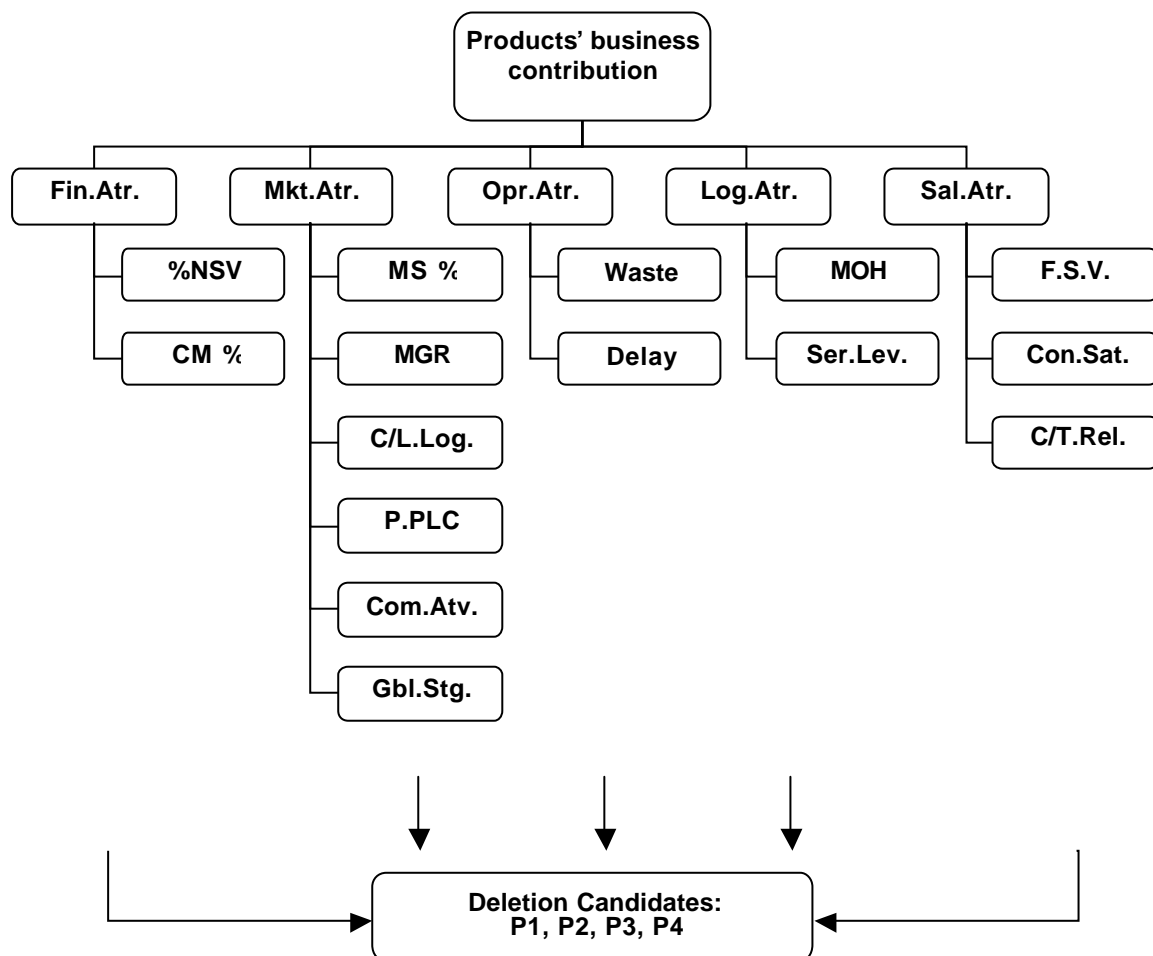
Note: For definitions of abbreviations used, see Table 3-1. Under each secondary criterion, there are four 'alternatives' represent the four deletion candidates under consideration. And the one with the lowest ranking is considered as the weakest-performed product, and should be the first one to be considered being deleted among the candidates.

Table 3-1.
Definition of Abbreviations Used

Abbreviation	Definition	Chariteristic
Fin.Atr.	*Financial Attributes*	
% NSV	The Product's share of the Company's total net sales value.	(Quantative)
CM %	The Product's contribution margin ratio.	(Quantative)
Mkt.Atr.	*Marketing Attributes*	
MS %	The Product's current market share.	(Quantative)
MGR	The Product's projected market growth rate.	(Quantative)
C/L.Log.	The Product's fit with category / line logic.	(Qualtative)
P.PLC	The Product's position on its product life cycle curve.	(Qualtative)
Com.Atv.	Competitors' activities for the Product's competitive product(s).	(Quantative)
Gbl.Stg.	Parent organization's global-wide strategic reasoning for the Product.	(Qualtative)
Opr.Atr.	*Operations Attributes*	
Waste	Shutdown, transition (for no shutdown situations), start-up, etc. (Waste directly associated with the Product)	(Quantative)
Delay	Grade change time, start-up time, period of reduced speed, etc. (Delay directly associated with the Product)	(Quantative)
Log.Atr.	*Logistics Attributes*	
MOH	The Product's current months-on-hand analysis.	(Quantative)
Ser.Lev.	The Product's required service levels. (i.e., special needs for order processing, delivery, warehousing, or high sales returns, etc.)	(Quantative)
Sal.Atr.	*Sales Attributes*	
F.S.V.	The Product's projected future sales volume.	(Quantative)
Con.Sat.	Impact on consumer's satisfactions if the product is deleted.	(Qualtative)
C/T.Rel.	Impact on customers/trades relationship if the product is deleted.	(Qualtative)

spiral' syndrome as described earlier; (2) the Product's contribution margin ratio (CM ratio)[8], which can be used to tell how much profit the Product has actually made for the company.

Marketing department has come up six sub-criteria to address the Product's current profile, containing both qualitative and quantitative types of judgments: (1) the Product's current market share, and (2) the Product's projected market growth rate, both of afford-mentioned factors are calculated base on the monthly report from AC Nielsen; (3) the Product's fit with its category / line logic; (4) the Product's position on its PLC curve; (5) competitors' activities (e.g., SOV[9], TVC[10], etc.) for the Product's competitive product(s); and (6) parent organization's global-wide strategic reasoning for the Product.

From an Operations standpoint, for both 'fully utilized' and 'less than full' machine loading conditions, (1) the Product's waste, which includes: shutdown waste (for SKU change), transition waste (for no shutdown required SKU change), and waste incurred to achieve centerline operation; and (2) the Product's delay, which includes: SKU change time (machine set-up, wash-up, etc.), start-up time, and period of reduced speed, are all important factors to be considered. For both of afford-mentioned factors, it is assumed that poor quality has been converted to waste and therefore 'quality concerns' is not a factor. Cycle time impacts can be also described completely by the above factors, so is not an issue itself for operations either; however, a low volume SKU that requires many months of inventory to

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[8] Contribution margin is sales revenue less variable costs. It is the amount available to pay for fixed costs and provide any profit after variable costs have been paid; the formula is $CM\ ratio = \dfrac{Contribution\ margin}{Sales}$.

[9] SOV is the abbreviation for 'Share of Voice'.

[10] TVC is the abbreviation for 'Television Commercial'.

be produced to achieve an 'economical run time' on a machine will impact warehouse utilization and even quality if left to sit too long between production runs.

Logistics has decided not to use 'inventory turnover' as a measuring criteria; instead, 'Months-on-hand' (MOH)[11] was adapted as the first criteria for a simple reason: 'MOH is a significant improvement over inventory turnover because it uses units rather than cost (Robison, 2001).' For example, inventory turnover implies that one $10 item is equal to two $5 items, even when the $5 item is backordered and there is a lifetime supply of the $10 item. If the customer needs the $5 item, then that item is more important to the customer and, it is hoped, to the organization, than the entire stock of $10 items. Financial ratios such as inventory turnover should not be used to manage inventory. The other logistics subcriteria is the 'service level', which lumps all of the special needs for the Product's order processing (e.g., quantity and frequency of orders, etc.), delivery (e.g., locations, lead-time, quantity and frequency of deliveries, etc.), warehousing (e.g., space utilization, etc.), or high sales returns, etc.

Sales department thinks: (1) the Product's future sales volume is the most important factors in distinguishing the weakly-performed products among the deletion candidates; however, it is also important not to (2) lose credit on consumer's satisfactions by deleting the product(s) that is(are) hard to be substituted; and (3) the impact on customer / trade relationship should be minimized, too.

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[11] The MOH formula is average monthly inventory divided by monthly demand, both in units.

3.4 Research Design

Because product deletion candidates may consist of products that are: (1) across product lines, or (2) within the same product line. Besides, the product-review committee believes that decision-makings are different between 'across product lines' and 'within the same product line' situations, since the marketing resources (e.g., advertising and promotion spending) are usually distributed at product line level rather at SKU level The product-review committee has decided to design two studies, representing the two different situations, to put AHP to test.

Study 1

The alternatives shown in study 1 for demonstration includes four products (i.e., P1, P2, P3, and P4) from four different product lines, each of which has its own weakness in delivering the expected performance. The parent organization views P1 as a successful product in other countries within the Asia-pacific region, but it failed to do well in the Taiwan's market. P2 was launched as a channel specific product with marginally sales and profit, but it disturbs the whole line logic. P3 has a good market growth potential and still at its early stage on the PLC curve, while the market is pretty much dominated by the first-mover product from a big competitor. P4 splits the market share with its only other competitive product, but the market base is restricted to only a group of consumers with limited demand.

Study 2

The alternatives in study 2 for demonstration comprise four products (i.e., P1', P2', P3', and P4') within the same product line. In this case, P1' and P3' are essentially the same for they

have the same feature but different in pack-count. The same situation for P2' and P4'. To the company, the feature (i.e., the material used) for P1' and P3' is better than that for P2' and P4'; however, the company has experiencing a hard time to convince consumers of higher price charged on better products. This explains why the company has been investing heavy promotion dollars in persuading consumers to try out P1' and P3'.

3.5 Data Collection

After the 'decision hierarchy' has been structured, the next step is to collect the comparison input data for each element of the tree with respect to the next higher level. The Program uses the nine-point dominance-scaling approach suggested by Satty (1980). The fundamental scale to use in making the comparison consists of verbal judgments ranging from equal to extreme (equal, moderately more, strongly more, very strongly more, and extremely more). Corresponding to those verbal judgments are numerical judgments (1, 3, 5, 7, 9) and compromises (2, 4, 6, 8) between these judgments (Lilien and Rangaswamy, 1998).

In this process, the committee members carried out only simple pairwise comparison judgments in the array of each 'criteria' to another 'criteria', which were then used to develop overall priorities for ranking the alternatives. The Program allows for inconsistency in the judgments and includes a way to improve consistency. The result of importance of primary criteria is shown in Table 3-2.

Table 3-2.
Pairwise Comparisons of Importances of Primary Criteria

	Fin.Atr.	Mkt.Atr.	Opr.Atr.	Log.Atr.	Sal.Atr.
Fin.Atr.	1	1/4	1/7	1/8	1/6
Mkt.Atr.	4	1	1/6	1/7	1/4
Opr.Atr.	7	6	1	1/2	3
Log.Atr.	8	7	2	1	2
Sal.Atr.	6	4	1/3	1/2	1

Criterion	Weight	Bar
Fin.Atr.	.544	████████████████████████
Mkt.Atr.	.264	████████████
Opr.Atr.	.055	██
Log.Atr.	.042	█
Sal.Atr.	.094	███

Inconsistency Ratio = 0.07

Note: For definitions of abbreviations used, see Table 3-1.

Table 3-2 forms the pairwise comparison matrix for all of the selected criteria (C), which gives the relative importance of Ci as compared with Cj. Using a 1~9 scale. With scale (S) S $ij = 1$ if the two criteria are equal in importance, S $ij = 3$ if Ci is moderately more important than Cj, S $ij = 5$ if Ci is strongly more important than Cj, S $ij = 7$ if Ci is very strongly more important than Cj, S $ij = 9$ if Ci is extremely more important than Cj. After computing the sum of each column and then divide each column by the corresponding sum to normalize the weights, then the weight for each criterion is calculated in respect to the goal, which will sum up to 1 when adding up all of the weight.

The Program not only does the calculation of priorities based on user's judgments, it also produces a measure of inconsistency. This measure is useful in identifying possible errors in

expressing judgments as well as actual inconsistencies in the judgments themselves. An inconsistency ratio of 0.1 or more may suggest some investigation to re-exam the pairwise comparison made. This is just a mathematical way to reassure that consistency is maintained during the pairwise comparison process.

The same steps were repeated for the subcriteria and the alternatives, the comparison data were then converted to relative weights of the decision elements. Complicated as it might look, it is relatively easy to do the pairwise comparison once the respondent understood and started the process. It actually took the product-review committee less than thirty minutes to go through the whole process.

Chapter 4
Findings and Discussion

Once the hierarchy had been structured, and all of the criteria, subcriteria and alternatives' weights derived through the hierarchical weighting process, the final step was to 'synthesize' the weights to rank the alternatives. Synthesis is the process of weighting and combining priorities throughout the model that leads to the overall results. Synthesis from the goal means multiplying the weight of each primary criteria times the local priorities of its subcriteria and of those subcriteria (if there is more than three levels) times the local priorities of their secondary subcriteria. This process continues down to include all the alternatives. Using hierarchical composition, the weights of the decision elements are aggregated and the composite priorities of each element at each level are obtained. Ultimately, this procedure provides an overall numerical ranking of the available alternatives.

4.1 Results of Study 1

Study 1 contains four products from four different product lines. The synthesized individual weights for each criteria, subcriteria, and alternatives are expressed in Table 4-1. The overall inconsistency index for study 1 is at 0.05, far less than the Program's suggested 0.1, meaning that the decisions made for all of the pairwise comparisons by the product-review committee were reasonably consistent.

Table 4-1.
Overall Synthesized Weights and Ranking of Alternatives for Study 1

LEVEL 1 LEVEL 2 LEVEL 3

Fin.Atr.=.544
  % NSV =.436
    P2 =.370
    P1 =.029
    P4 =.020
    P3 =.017
  CM % =.109
    P3 =.035
    P2 =.032
    P1 =.029
    P4 =.013
Mkt.Atr.=.264
  MGR =.103
    P3 =.046
    P4 =.026
    P1 =.019
    P2 =.011
  MS % =.073
    P4 =.035
    P2 =.022
    P1 =.012
    P3 =.004
  C/L.Log.=.041
    P4 =.020
    P3 =.015
    P1 =.003
    P2 =.002
  P.PLC =.027
    P3 =.011
    P1 =.008
    P4 =.005
    P2 =.003
  Com.Atv.=.014
    P4 =.005
    P2 =.004
    P3 =.003
    P1 =.001
  Gbl.Stg.=.008
    P1 =.005
    P3 =.001
    P4 <.001
    P2 <.001

LEVEL 1 LEVEL 2 LEVEL 3

Sal.Atr.=.094
  F.S.V. =.048
    P4 =.020
    P3 =.014
    P2 =.009
    P1 =.004
  Con.Sat.=.026
    P4 =.010
    P3 =.008
    P1 =.005
    P2 =.003
  C/T.Rel.=.020
    P2 =.008
    P4 =.006
    P3 =.004
    P1 =.002
Opr.Atr.=.055
  Waste =.041
    P2 =.011
    P4 =.011
    P3 =.010
    P1 =.009
  Delay =.014
    P4 =.006
    P2 =.004
    P3 =.003
    P1 =.002
Log.Atr.=.042
  MOH =.024
    P2 =.010
    P1 =.007
    P4 =.005
    P3 =.003
  Ser.Lev.=.017
    P2 =.007
    P1 =.005
    P3 =.004
    P4 =.002

|		
P2	**.496**	████████████████████████
P4	**.186**	████████
P3	**.177**	████████
P1	**.142**	██████

OVERALL INCONSISTENCY INDEX = 0.05

Note: For definitions of abbreviations used, see Table 3-1.

The overall ranking suggests that P1 (with the overall global weight of 0.142) is the weakest-performed product, and should be the first one to be deleted among the candidates, followed by P3, and then P4 (at 0.177, and 0.186, respectively). P2 (at 0.496) is the most highly performed product, and should be the last one to be deleted if necessary. The company's product-review committee confirms that the result is actually in concurrence of the company's management deliberation before they have been through the AHP process.

The individual weights reveal that, from financial perspective, P2 clearly outperforms P1, P3, and P4, even though its contribution margin comes in second but it still delivers much higher net sale value to the company than P1, P3, and P4 do. Logistics also favors P2 for its higher turnover and un-favors the slowly-moving and relatively hard-to-service P4 and P3. However, marketing views P2 should be the first one to be deleted from the product offerings, since it is a channel-specific product which not only disturbs the whole line logic but also has limited market growth potential. Marketing would rather spend more resources on developing P4 and P3 to turn them into the future winning products for the company. Sales agrees with Marketing that P4 and P3 are starting to gain some attention from customers so it will be unwise to just delete them from the product offerings.

Another function included in the Program is to perform the sensitivity analysis, which is used to investigate the sensitivity of the alternatives to changes in the priorities of the criteria. The sensitivity analysis also aids in validating the result. The analysis from the 'goal' will show the sensitivity of alternatives with respect to the criteria immediately below the goal for study 1, as shown in Figure 4-1, to provide the 'eyeballing' results for easier understanding as well.

Figure 4-1.
Performance Sensitivity with Respect to Goal for Study 1
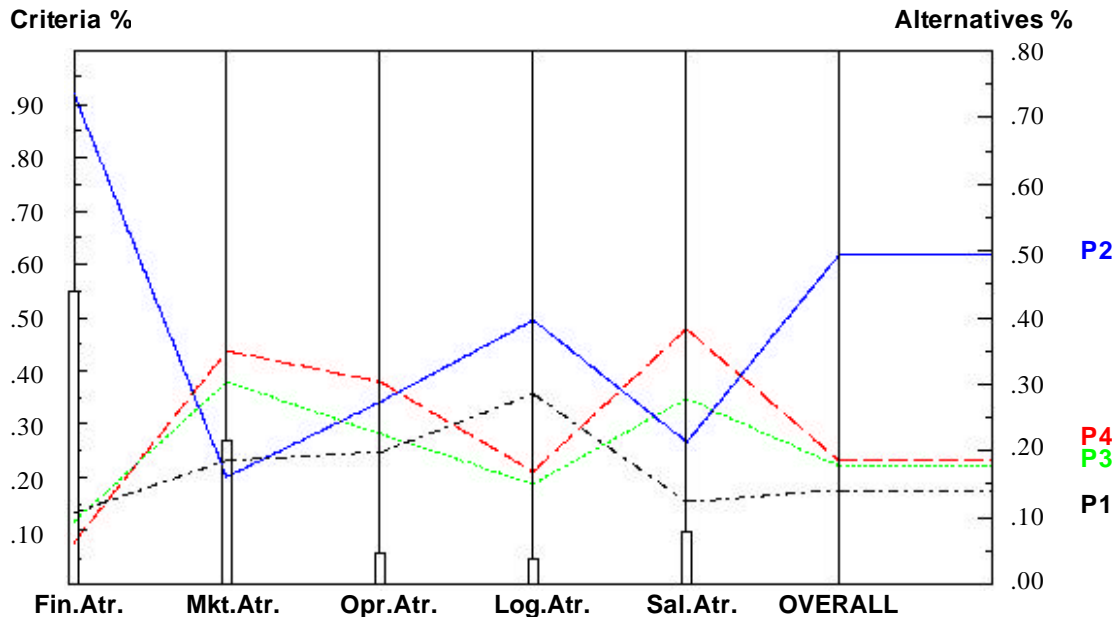
Note: For definitions of abbreviations used, see Table 3-1.

As seen in Figure 4-1, the 'non-financial' factors (i.e., 'Mkt.Atr.', 'Opt.Atr.', 'Log.Atr.', and 'Sal.Atr.') have taken effect on the overall ratings. For example, P4 was ranked at the lowest in 'Fin.Atr.', but scored second in 'OVERALL' because of the better ranking in 'Mkt.Atr.', 'Opt.Atr.', and 'Sal.Atr.'. This finding suggests that when comparing products across product lines, both 'financial' and 'non-financial' factors count in the evaluation of product performance.

4.2 Results of Study 2

Study 2 contains four products within the same product line; the differences are in features and pack-count. The synthesized individual weights for each criteria, subcriteria, and alternatives are documented in Table 4-2.

A couple of noticeable signs were observed by comparing the individual weights. First, the ranking patterns for the individual alternatives are similar across all functional attributes with the exception of the 'Opr.Atr.' criteria, which is also evidenced by comparing the weights for the 'CM %' subcriteria. The message send implies that P1' and P3' cost the company more to produce than P2' and P4' do; however, the higher costs might be contributed from not only the more expensive materials used for P1' and P3' as the company thought it should be. What is also contributed to the unfavorable situation is the higher waste generated by P1' and P3' from manufacturing. Second, the gaps among these four products are much narrower in the 'Mkt.Atr.' criteria when compare to the result of study 1. The underlying rationale is that marketing resources (i.e., advertising and promotion spending) are usually programmed at the product line level and rarely at the individual SKU level, and thus each product within the same product line usually shares the same level of supporting.

The overall ranking suggests that P3' and P4' (at 0.151, and 0.152, respectively) are both not performing well, and should be considered to be deleted among the candidates first. P1' (at 0.386) is the strongest product, and should be the last one to be deleted if necessary. Again, the result could be validated by running the sensitivity analysis for study 2 as shown in Figure 4-2.

Table 4-2.
**Overall Synthesized Weights and Ranking of Alternatives for Study 2**

LEVEL 1 LEVEL 2 LEVEL 3	LEVEL 1 LEVEL 2 LEVEL 3
Fin.Atr.=.544	Sal.Atr.=.094
% NSV =.436	F.S.V. =.048
P1' =.228	P1' =.017
P2' =.160	P2' =.014
P3' =.027	P3' =.009
P4' =.021	P4' =.008
CM % =.109	Con.Sat.=.026
P4' =.031	P1' =.007
P2' =.028	P2' =.007
P3' =.026	P3' =.006
P1' =.024	P4' =.006
Mkt.Atr.=.264	C/T.Rel.=.020
MGR =.103	P1' =.005
P4' =.027	P2' =.005
P3' =.027	P4' =.005
P1' =.023	P3' =.005
P2' =.024	Opr.Atr.=.055
MS % =.073	Waste =.041
P1' =.035	P4' =.013
P2' =.026	P2' =.011
P3' =.007	P3' =.010
P4' =.005	P1' =.008
C/L.Log.=.041	Delay =.014
P1' =.010	P4' =.005
P2' =.010	P3' =.003
P3' =.010	P1' =.003
P4' =.010	P2' =.003
P.PLC =.027	Log.Atr.=.042
P1' =.007	MOH =.024
P2' =.007	P1' =.008
P3' =.007	P2' =.007
P4' =.007	P3' =.005
Com.Atv.=.014	P4' =.005
P4' =.004	Ser.Lev.=.017
P3' =.004	P1' =.005
P1' =.003	P2' =.005
P2' =.003	P4' =.004
Gbl.Stg.=.008	P3' =.004
P3' =.002	
P4' =.002	
P2' =.002	
P1' =.002	

P1'	**.386**	████████████████████████
P2'	**.311**	███████████████████
P4'	**.152**	██████████
P3'	**.151**	██████████

OVERALL INCONSISTENCY INDEX = 0.05

Note: For definitions of abbreviations used, see Table 3-1.

Figure 4-2.
Performance Sensitivity with Respect to Goal for Study 2
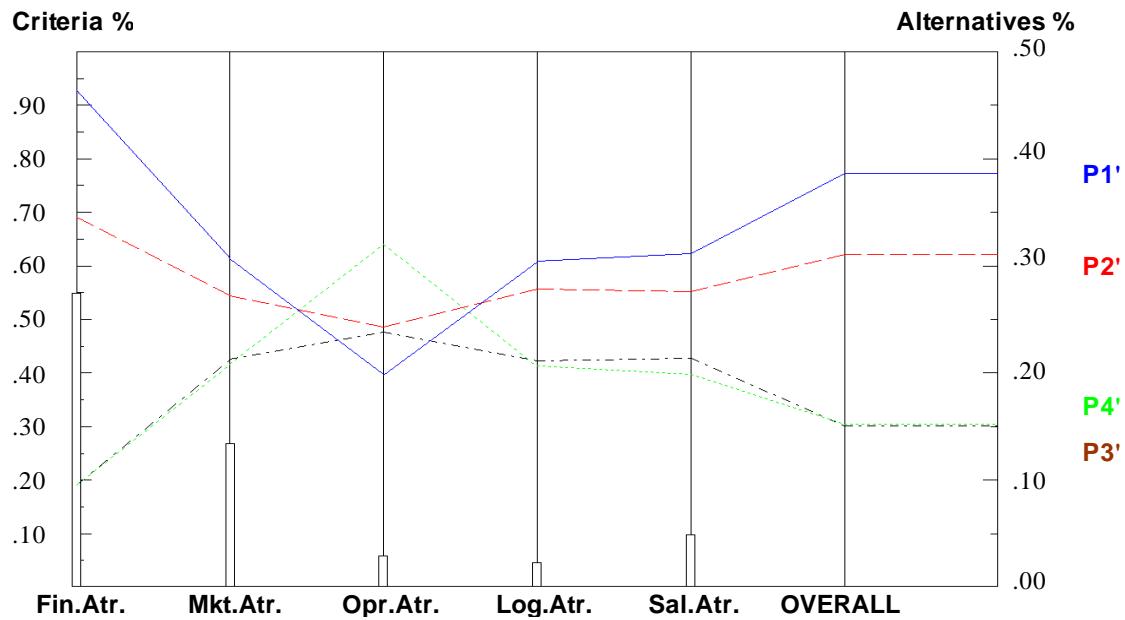
Note: For definitions of abbreviations used, see Table 3-1.

As seen in Figure 4-2, most of the 'non-financial' factors (except 'Opt.Atr.') have the similar ranking results as the 'financial' factor (i.e., 'Fin.Atr.') does. The product-review committee has concurred the results and explained that since the amount of resources (i.e., Advertising and promotion spending, sales efforts) are equally available for products within the same product line, so the products' business contribution can be distinguished solely from the financial performance. In another words, 'financial' factor seems to be more sufficient as a single index to determine the individual product's performance.

4.3 Key Findings from the Results

A few key findings can be drawn by comparing the results from study 1 and 2:

(1) The AHP seems to satisfy the company's requirement for a systematic and analytic tool. The AHP has helped to convert and quantify both the 'tangible' and 'intangible' managerial decisions into a solid and challengeable format, so the decisions were not made only based on a few managers' personal judgments. The AHP has also helped to structure the complexity multi-person, multi-criterion decision-making process into a more transparent format for a better understanding within a relatively short period of time (less than thirty minutes of time to go through the whole process).

(2) The results obtained for both scenarios from AHP seem to agree with the managerial deliberation, since each function has contributed its expertise into the decision-making process. Also, because managers typically rely on only a subset of information (e.g., using heuristics), the AHP helps managers make 'more rational' decisions by structuring the decision as they see it and then fully considering all of the information. The process has also helped each function to understand where other functions' concerns are. Consensus could be reached much easier after the measuring criteria are set clear.

(3) When comparing products across product lines, both 'financial' and 'non-financial' factors count in the evaluation of product performance; however, in the situation of products are within the same product line, 'financial' factor seems to be sufficient enough as an index to determine the product's performance, since resources are usually distributed at the product line level, rarely at the SKU level (e.g., advertising, sales

efforts, etc.). Thus, non-financial factors tend to impose less effect than the financial

factors do.

4.4 General Discussions

After going through the process, the product-review committee members noted the

following observations: (1) the 'hierarchical' process has helped screening out most of the

deletion candidates without the need of being through the whole exercise; and most of the

time, the corrective actions can be easily identified right away on how to rejuvenate the

products without many arguments. The reason why the decisions were harder to make before

is mainly due to the lack of understanding on how other functions' view towards the product

performance attributes; once the key factors being laid out and the priorities being set, then

the causes can be taken care of by the respective functions without shifting the load to other

functions and complicating the process. The whole exercise has provided a platform for

'consensus-building' across all functional departments. Once the consensus is reached, AHP

is only required for those 'hard-to-make' decisions, not all 1,800 products have to go through

the AHP process; (2) the 'formalized' process has helped in pulling all of the resources

together and derived all of the functional areas at the same direction. Also, the 'formalized'

process has pushed the need for the company to review the product portfolio periodically and

take proactive actions; (3) the 'decision hierarchy' has helped in establishing a baseline for

feasibility requirements when the company's designers are developing new product

applications. A new product can be compared to other successful products in the portfolio to

predict its score and compare it to the mean score of the portfolio. It also guides strategic

decisions about the need to either replace or complement a product; (4) the 'criteria' and

'weights' that were set for this time should not and will not be forever. In fact, the product-review committee has decided to run the AHP more times so to develop a 'norms', which can be then settle as a standard until further changes in 'conditions' (i.e., product, company, organizational and environmental conditions; referring back to Figure 2-2).

The aim of this study is not to analyze whether the company has made the 'perfect' decision on which product(s) to be deleted among the deletion candidates; the focus is rather on the emphasis of the rationale for product deletion will not always be due to one factor in isolation, especially when comparing products across different product lines. The idea is to build a hierarchy of attributes and weight them according to their importance. The process requires the participants to rank and weight variables independently. Then the individual results are compared to identify congruencies and repeated as needed to derive a clear consensus of priority.

As product deletion decisions affect the balance of resources, the practices of several functional areas within the organization, and sometimes the individuals and groups in the organization. The product deletion process naturally involves conflicts and negotiations among interested groups inside and even outside the organization. The process of formulating the model, testing it, and analyzing its results has served as a bridge for cross-functional communication and provided more valuable benefits to the company. Using the 'AHP' technique, an objective and reiterative consensus building process may be viewed as one way to understand common interests of finance, marketing, manufacturing, logistics, and sales.

Chapter 5
Conclusion

In a competitive environment fraught with increasingly product complexity, shorter lifecycles, and higher customer demands, it is imperative that companies keep the right product assortments to stay profitable in the market. This research focuses on a tactical approach by applying AHP to identify candidates for product deletion. In comparison with previous works in this area, our current research provides more complete evaluation factors (i.e., finance, marketing, operations, logistics, and sales) generally used by management and offers a richer explanation of why particular factors are deemed important by management in the product evaluation process.

The main conclusions to be drawn from the two studies in the identification of product deletion candidates specific to the subject company are: (1) AHP proves to be a sophisticated and useful management science tool in conceptualizing and converting the nonfigurative managerial thoughts into measurable index for identifying product deletion candidates; (2) both 'financial' and 'non-financial' factors play critical roles in the evaluation of product performance; however, in the situation of products within the same product line, 'financial' factor seems to be more sufficient as a single index to determine the individual product's performance.

5.1 Managerial Implications

The findings of this study have some important managerial implications: (1) building a model for evaluating product deletion candidates should be contingent on the characteristics

of product, firm, and industry. Any attempt to over generalize a particular model calibrated by a specific case to fit all of the conditions (i.e., different products, firms, and industries) would be unwise; (2) better accounting information is not the cure for complex product deletion decisions if organizations continue to make decisions from a departmental 'silos' view rather than from a 'strategic' view across the enterprise; (3) the unaided human mind is simply not capable of organizing all the factors needed to make a decision and determine from their interactions the most likely outcome; (4) without a clear understanding of why products become weak, the ability to plan their removal without damaging other business objectives may be compromised; (5) the 'hierarchical' process may benefit management in understanding product deletion concerns across different functions and simplify the process; (6) monitoring the causes of product deletion not only should be regulated as an on-going activity, but also should be 'formalized,' which can help to arrange all of the resources together and coordinate all of the functions to head toward the same direction; (7) the same logic that are used to evaluate products' business contribution for product deletion can also be utilized in assisting for new product development or product modification.

5.2 Limitation of the Current Research

The study reported here represented the first attempt to examine the identification of product deletion candidates by adapting the use of AHP to quantify both financial and non-financial factors in the decision-making process. However, generalizing the results of an exploratory study from self-reporting data obtained solely from one selected company of the Taiwan FMCG industry must be undertaken with much caution.

5.3 Directions for Future Research

Future research should concentrate on deletion triggers that may exist in other business sectors so as to expand the overall conceptual base of why products become weak and need to be deleted. This should focus on both tangible and intangible attributes to the products' performance evaluation, also the quantitative and qualitative impacts of product deletion. In addition, future research should be directed at how organizations set up a planning system to regularly evaluate the product assortments and determine which ones to be eliminated from the portfolio. Product deletion decisions should be made on a strategic basis, rather than on a crisis basis.