CHAPTER 2: INTRODUCING NEW PRODUCTS AND SERVICES

No business activity attracts so much attention and optimism, and is so fundamental to corporate strategy, as introducing new product or service. It is a chance for renewal, redirection, and getting a step on the competition. Yet such promises are seldom fully realized. Preliminary market studies sometimes misjudge what the customers really want. And what works in a pilot plant can flop miserably in full-scale production.

Previous chapter explained how corporate strategy defines a firm's mission and answers to questions such as, What business are we in? What should it be ten years from now? Who are our customers? The answers define the products and services the firm will offer. Although planning in this area takes place primarily at the corporate strategy level, it is the logical starting point for formulating operations strategy. Knowing the characteristics of the products and services, the operations manager can effectively design and operate the production system.

2.1. PLANNING NEW PRODUCTS AND SERVICES

Product and service planning encompasses all the activities leading to the introduction, revision, or dropping of products and services. The planning process is ongoing – it's the job that's never completed. Intense competition, expiration of patents, and rapid technological innovations are all factors that challenge an organization's ability to produce a quality product or deliver a quality service that meets market demand and is timely. Corporate strategy guides the process because the planning must be compatible with a firm's overall goals.

More than $50 billion are spent each year designing new products or improving old ones. In fact, more than 50% of firm's sales dollar volume typically comes from products or services introduced within the last 10 years. Large firms often spend vast sums of money assessing the market, appraising the competition, and designing products and services.

Here is the roadmap for the following sections on planning new products and services. We begin with life cycles and describe what's required of the operations

function as a product or service goes though the various stages of its life. A firm can enter a product's life cycle in any of these stages, which introduces entrance-exit strategies and how the strategy chosen affects the way a production system is designed and operated. Next we describe the four basic steps involved in planning new products and services. We conclude with three decision-making tools that are particularly relevant to this planning process: the preference matrix, break-even analysis, and reliability analysis.

Life cycles

A firm that neglects to introduce new products or services periodically will eventually decline. Sales and profits from any given product decrease over time, so the pressure is on management to introduce new products before existing ones hit their peak. Let's now look at the stages in the life of products and services.

Life-cycle stages

A life cycle consists of five stages through which a product or service passes (see Figure 1)

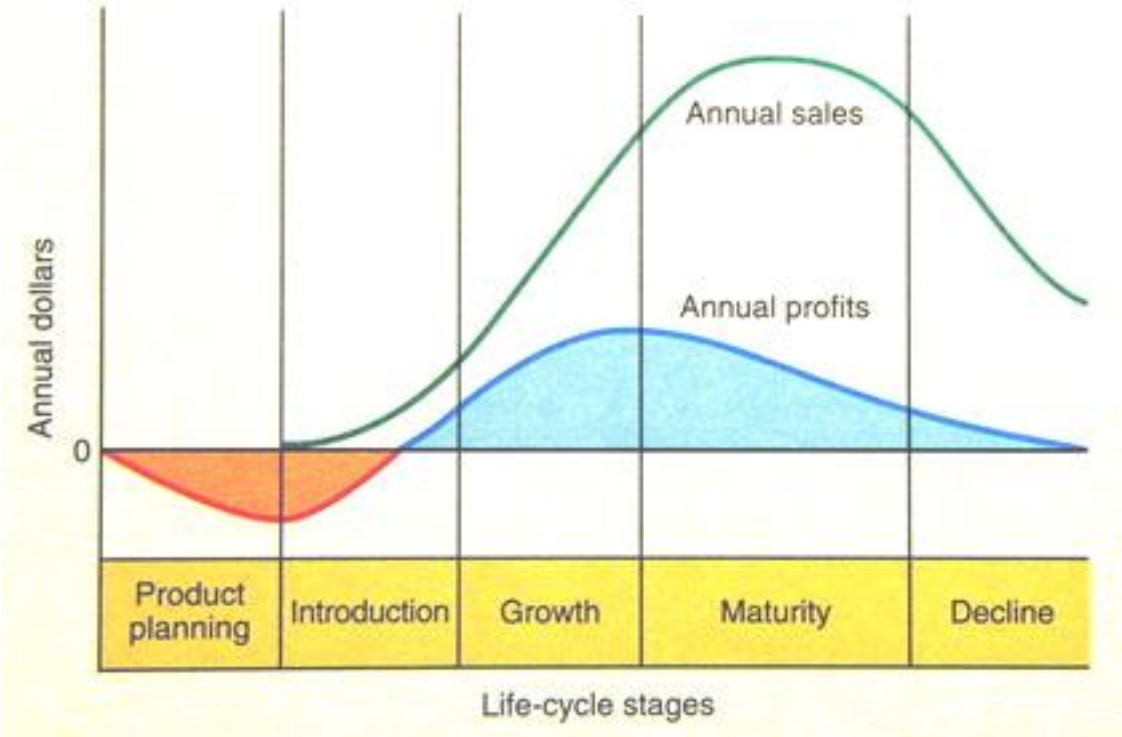


Figure 1. Life Cycle of Product or Service

1. **Product or service Planning.** During this stage, ideas for new goods or services are generated, screened, and translated into final designs. Profits attributed to a product or service are negative at this point, as sales have not yet begun. Although no revenues are coming, development costs are being incurred. Operations must be involved to ensure that the new product or service is in sync with production capabilities.
2. **Introduction.** At this stage, sales begin and profits go from negative to positive. Operations is still refining production efforts, which can best be characterized as fluid and evolving. Marketing efforts may be modest (as when introducing new prescription drugs) or nearing their peak (as with new textbooks). As sales volumes have not reached their high point, annual profits are small, even though unit profit margins may be large.
3. **Growth.** The product or service next enters a stage of rapid growth. Early in this stage, sales jump dramatically and profits rise. The mandate for operations is to somehow keep up with demand; efficiency is less of a concern.
4. **Maturity.** During this stage, sales level off and profits have begun to decline. New competitors create pressures to cut costs and slow the squeeze on unit profit margins. Now operations must stress efficiency, although marketing can ease the pressure by intensifying efforts to differentiate the product or service.
5. **Decline.** At last the product or service enters a decline stage and ultimately becomes obsolete. Either demand disappears or a better, less expensive product or service takes its place. Sales and profits decrease to the point where the firm finally drops it.

Life cycles vary greatly from one product of service to another. Looking only at the time, required for the product or service planning stage, or the time between idea generation and product introduction, we find that it took Eversharp only 8 months to introduce ballpoint pens. By contrast it took Gillette 13 years, $300 million, and 18 patents to introduce its Sensor razor. In the hi-tech computer and microchip industry, products can become obsolete in months. Thus companies such as Intel Corporation generally favor management style characterized by quick, independent actions more than do companies producing products or services that have longer life cycles.

Managing Life Cycles

A life cycle audit evaluates which stage a product or service is in, based on how changes in sales and profits compare with those of prior years. For example, when both sales and profits are dropping, Figure 1 suggests that the product is in either the late maturity stage or the decline stage. Life-cycle audits spot needs to revitalize or eliminate existing products and to introduce new ones.

Application: 1 Conducting a Life-Cycle Analysis

Management has collected the following data in preparation for a life-cycle audit of one of its products, a packaging material sold to industrial buyers.

Performance Measure	This Year's Performance	Change Over Last Year	Average Annual Change Over Last 4 Years
Annual Sales	$30.8 million	+1.0%	+15.8%
Unit Price	1.12 per lb	+2.2	+8.5
Unit Profit Margin	0.16 / lb	-0.3	+3.2
Total Profits	4.4 million	+1.5	+22.5

In what stage of life cycle is the product?

Solution

Sales are stabilizing, having grown only 1% over the past year. Average annual growth had been much higher during prior years at 15.8%. Unit-price growth has slowed, and unit profit margins are beginning to shrink. Total profit is also leveling off. All of these signs suggest the early maturity stage.

When life cycle audit indicates that a product or service has reached maturity or entered decline, management has several options. The firm can stay with the product or service for a few more years, find ways to squeeze costs still more, or revise and rejuvenate it. Table 1 shows how companies in five industries (drugs, major appliances, food, clothing, and minor appliances) ranked various product planning activities.

Table 1 / Importance of various product planning activities

	Activity	Importance
1.	Adding new products	41%
2.	Revising existing products	31%
3.	Finding new uses of existing products	15%
4.	Eliminating products	13%

Revision might mean improving the performance of the product, such as a mix for a faster rising cake. Or it could be an update of an old standby as with Mattel's revamp of the Barbie doll.

Entrance-Exit Strategies

The life cycle of a product within a company can be quite different from its cycle within industry. For example, a firm might decide to pull out of a particular market although the industry will be producing these products or services for years to come. An **entrance-exit strategy** is a firm's choice of when to enter a market and when to leave it. Choosing one of the three basic strategies shown in Table 2 has important implications for operation's function.

Table 2 / Entrance-Exit Strategies

Strategy	Stage to Enter	Stage to Exit	Implications for Operations
Enter **early** Exit **late**	Introduction	Decline	Transition from low-volume, flexible producer to high volume low cost producer
Enter **early** Exit **early**	Introduction	Maturity	Low-volume, flexible producer
Enter **late** Exit **late**	Growth	Decline	High volume, low-cost producer

Enter Early and Exit Late

The most natural strategy is for a firm to enter the market when a product or service is first introduced by the industry and stay with it until the end of its life cycle. Polaroid and Xerox are examples of companies that developed a new product and grew with it throughout its life cycle. By entering the market early, the firm gets a head start, this

added experience may allow the early entrant to produce a better product at a lower cost than late entrants can produce initially.

This strategy requires operations to evolve from a low-volume, flexible production system into a high-volume, low-cost system. Such a shift is always a challenge because it means changing over to a whole new way of doing things. Several companies in the personal computer industry, including Apple, Atari, etc. experienced similar growing pains when they moved from a small, freewheeling venture to a large corporation.

Enter Early and Exit Early

Small, product innovative firms often choose to stay in a low-volume, customized business. This strategy requires no painful transition. When the product reaches the maturity stage and profit margins begin to shrink, the firm drops the product and introduces new ones. Throughout the life cycle, operations management maintains a small, flexible production system that can be adapted readily to changing products or services.

Enter Late and Exit Late

A firm waits in the wings until other, innovative firms introduce new products. After it is clear that the product has significant market appeal and will achieve high sales volumes, the firm enters the market with an automated, efficient production facility. Larger firms, in particular, may accompany their entry with **preemptive pricing**, that is, setting their prices considerably lower than those of their competitors to ensure the high-volume sales necessary for low unit costs and to avoid a transition from low to high volumes. They can exploit their mass-marketing capabilities, establish distribution channels, and gain access to capital markets to finance the massive investment needed for top efficiency. A good example in the service sector is United Parcel Service, the package-deliver giant with 237,000 employees and $12.4 billion in revenues, which is muscling into the overnight-express business to compete head-to-head with Federal Express, the innovator in overnight express mail. UPS has made $1.5 billion in improvements to its system of tracking and scheduling deliveries and guarantees 10:30 A.M. next-day delivery in more locations than Federal Express. It also is offering large discounts to large-volume customers.

The planning process

The planning process for new products and services is most active during the first stage of the life cycle. As Figure 2 illustrates. It is a four-step process, guided by corporate strategy. An essential part of strategic planning, the firm's mission plays a key role in the conceptualization and design of new products and services. If its mission is too broad, the firm could enter areas in which it has no distinctive competencies. If the mission is too narrow, promising growth opportunities will be missed.

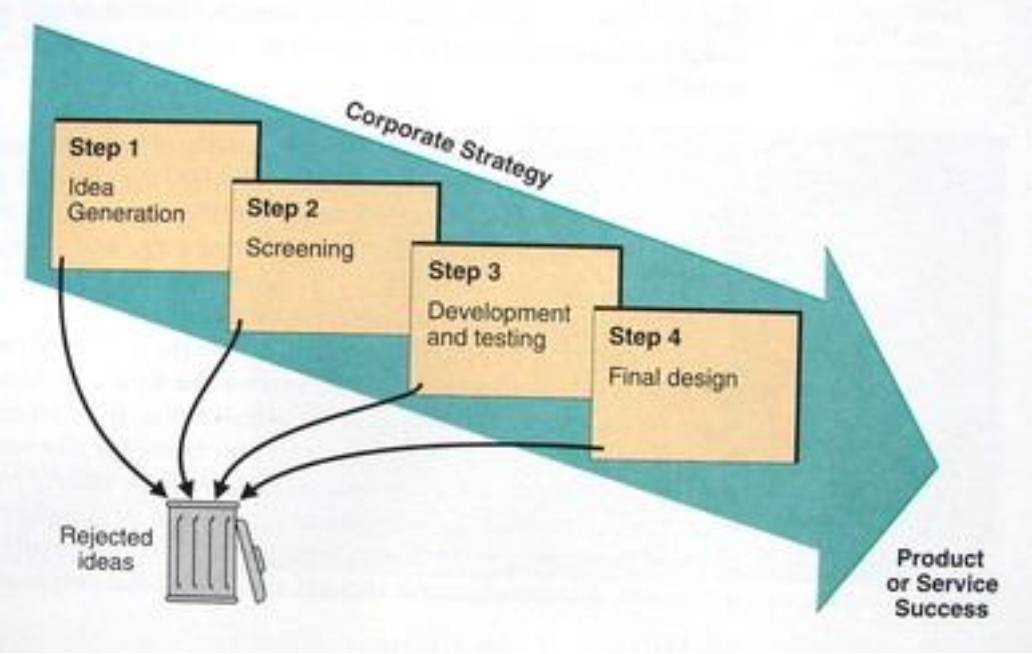


Figure 2 Steps in Planning New Products and Services

Step 1: Idea Generation

Ideas for new products or services often come from within the firm – from managers, employees, or research and development (R&D) laboratories. They also come from the outside – from distributors, licensers, and inventors. You may be surprised to learn that Du Pont, known for its innovative products, gets two-thirds of its new product ideas from outside source.

New ideas are either *market oriented* or *technology oriented*. The most obvious source of new ideas is marketing, the department responsible for keeping in touch with customer and client needs. Market studies discover better ways to serve established markets, as well as opportunities to enter new ones. Examples of successful market-oriented ideas are dial-a-call services by psychologists, fast-food

delivery service to students living in dormitories, low-cost new summary transmissions to radio stations via facsimile machines, and McDonald's low-fat hamburgers.

Technological advances can affect either the product of the process. Consider the innovations in the electronics and computer industries that are spawning many new products. Other inventions improve the production process, which in turn creates opportunities for more new products. For example, automatic teller machines have allowed banks to offer their customers 24-hour service. Large firms do most of the industrial R&D work, with some 80% of R&D being done by the firms employing more that 5000 persons. Many of the new product ideas are generated by the half million scientists whose industrial research costs billions of dollars each year. Some successful technology-oriented ideas include laser surgery, Du Pont's super tough Kevlar fiber etc.

Step 2: Screening

There is never a dearth of new product or service ideas. NBC estimates that it wades through 250,000 suggestions or ideas every year. The real question is, Which ideas are worth pursuing? By one estimate, only 8 of every 60 ideas make it past the screening step, and only 1 is actually commercialized. Some ideas do not fit the company's mission. Others fail to meet marketing, operations, or financial criteria.

Marketing Criteria help managers measure the potential impact of a new product or service on the competition and on the firm's existing product line. Criteria include competitiveness, responsiveness to market needs, the idea's patent status, promotional requirements, need for after-market services, and fit with existing distribution channels. *Operations Criteria* include feasibility of producing a product or service and its compatibility with the firm's current processes, work force, equipment, facility locations, and supplier capabilities. *Financial Criteria* include the size of the corporation, investment required, degree of risk, predicted annual sales, profit margin per unit, and anticipated length of a product's or service's life cycle. Marketing criteria relate mainly to future revenues, whereas operations criteria relate directly to cost. In a sense, the financial tests bring marketing and operations together. There are important nonfinancial considerations (ethics and environment) that need to be part of decision process. Although most ideas are discarded during screening, there is no

guarantee that an optimal decision will be made, as history of the following ill-fated products suggests:

- After painstaking market research, Ford launched the Edsel car with much fanfare. One enthusiastic dealer even unfurled a huge Edsel sign above San Francisco Bay. But the company's high expectations went unmet, as Ford sold only about 100,000 of the cars.
- Extensive taste tests convinced Coca-Cola executives that customers would prefer a new flavor of the world's best-selling soft drink. They were surprised by consumer response, however, so we can now buy the new Coke and "Classic" Coke.

There are two reasons for such failures. First, a great deal of uncertainty surrounds the choice. Making accurate forecasts of future sales, costs, and competitor reactions is difficult, if not perilous. Historical data for totally new products are nonexistent. Second, multiple criteria cannot be naturally merged into a single measure (such as dollars). Managers are hard pressed to estimate the dollar equivalent of intangibles such as operations compatibility or project risk. Later, we will discuss tools managers use in decision making.

Step 3: Development and testing

Next, the firm must test the idea's technical feasibility by considering a variety of factors. In manufacturing industries, engineers may design prototypes for testing and analyzing a product's features. Operations assesses process, facility, and material needs. Finally, marketing conducts tests in limited markets or with customer panels to gauge consumer response to the product's features, packaging, and promotional campaign. The end result of testing should be a product that is technically and economically feasible and that has customer appeal.

The U.K. firm British Aerospace estimates that decisions made during the first 5% of step 3 determine 85% of a product's eventual quality, cost, and ease of manufacture. Historically, engineering designed the product first and only then would manufacturing get involved. Engineers worked in virtual isolation. Their prototypes were not deigned for efficient production and assembly, costly changes and retooling were common, and often the development process was delayed. Today, increased market segmentation and declining life cycles make short development cycles critical.

This realization has prompted many firms to involve operations in development and testing from the outset. In a process called **concurrent engineering** (and sometimes "simultaneous engineering" or "interactive design"), design engineers, manufacturing specialists, marketers, buyers, and quality specialists work jointly to design the product or service and to select the production process. Firms implement concurrent engineering in somewhat different ways.

> Following the precedent established by its Taurus/Sable program, Ford now gives full responsibility for each new product to a program manager. The program manager forms a product team representing every major part of the organization – including manufacturing. Thus each department can express its views while there is still time to alter the product. Changes at this step are much simpler and less costly than after the product of service has been introduced to the market.
>
> Motorola Lighting Inc. brought together teams from engineering, marketing, and manufacturing to design its electronic ballasts (the transformers that run fluorescent lighting systems). At that time 22 employees worked in a single room at Motorola headquarters, where "everybody's business was everybody's business".
>
> This concept of working together is also a tradition at Honda, where animated discussions among representatives of all departments have earned the nickname *waigaya*, which loosely translates into "hubbub".

In service industries, firms must define and assess three components of the "service bundle" (1) facilitating goods (2) explicit services, and (3) implicit services. To illustrate, in restaurant, facilitating goods include food, drink, tables, chairs, and tableware. Explicit services include speed and quality of service and less tangible characteristics such as taste, aroma, and atmosphere. Implicit services are harder to define because they depend on customer preferences. They could include perceptions of status, comfort, or a general sense of well-being.

Restaurant chains generally begin with a carefully designed prototype. K David Thomas founded Wendy's Old-Fashioned Hamburger in 1969. For the first site, in Columbus, Ohio, he defined the details of product features such as menu, interior décor, and order processing service. Only after finishing the development and testing stage did Wendy's begin to expand and sell franchises.

Step 4: Final Design

During this step, the firm finalizes the details of product or service characteristics, often by lists of specifications, process formulas, and drawings. For example, engineering drawings for and electric utility boiler would specify types of material and dimensions for each component. This is the stage at which firms commit substantial financial and human resources to the project. Then production begins. Marketing starts its promotional program with kickoff sales meetings and presentations at trade exhibits. In services, a supermarket would establish maximum customer delay times.

Decision-Making Tools

Managers must decide which new products and services to introduce and then select their particular design features. Sometimes hard thinking in a quiet room is sufficient. At other times decision makers rely on more formal procedures. We present only three of these formal procedures: a preference matrix, break-even analysis, and reliability analysis. The preference matrix helps a manager deal with the multiple criteria that are always part of decisions on which new products or services to introduce. Break-even analysis helps the manager identify the level of sales necessary to make a new product or service a profitable venture. Reliability analysis is particularly relevant for the development and testing step when different product or service designs are being evaluated.

Preference Matrix

A preference matrix is a table that allows the manager to rate an alternative according to several performance criteria. The criteria can be scored on any scale, such as from 1 (worst possible) to 10 (best possible), as long as the same scale is applied to all the alternatives being compared. Each score is weighted according to its perceived importance, with the total of these weights typically equaling 100. The total score is the sum of the weighted scores (weight times score) for all the criteria. By rating various alternatives, the manager can compare the scores for new product ideas against one another or against predetermined threshold.

Application 2: Evaluating and Alternative with a Preference Matrix

The following table shows the performance criteria, weights, and scores (1 = worst, 10 = best) for a new product, a thermal storage air conditioner. If management wants

to introduce just one new product, and the highest total score of any of the other product ideas is 800, should the firm pursue the air conditioner?

Performance Criterion	Weight (A)	Score (B)	Weighted Score (A x B)
Market potential	30	8	
Unit profit margin	20	10	
Operations compatibility	20	6	
Competitive advantage	15	10	
Investment requirement	10	2	
Project risk	5	4	
		Total Weighted score	

Solution: We calculate the first weighted score in the last column of the table as 240 (30*8). Continuing down the column, the results are 200, 120, 150, 20 and 20. Next we sum these weighted scores, for a total of 750. This score falls short of the 800 threshold, so we would not pursue the thermal storage air conditioner idea at this time.

Not all managers are comfortable with the preference matrix technique. It requires the manager to state criterion weights before examining the alternatives, although the proper weights may not be readily apparent. Only after seeing the scores for several alternatives can the manager decide what is important and what is not. The preference matrix also allows a low score on one criterion to be compensated for or overridden by high scores on others, which may or may not be realistic. For example, the investment required for a new manufacturing process might exceed the firm's financial capability. In that case the new product or service idea must be dropped, no matter how high the scores were for the other criteria.

Break-even analysis

When used for product or service planning, break-even analysis is a technique for determining the volume at which total revenues are equal to total costs. When used to compare production methods, it finds the volume at which two different processes have equal total costs. Here we use it for the first purpose: to evaluate the profit potential of a new product or service. This technique helps the manager answer questions such as:

1. Is the predicted sales volume of the product or service sufficient to break even (neither earning a profit nor sustaining a loss)?
2. How low must the variable cost per unit be to break even, based on forecasts of sales and prices?
3. How low must the fixed cost be to break even?
4. How do price levels affect the break-even volume?

Break-even analysis assumes that all costs related to the production of a specific product or service can be divided into fixed costs and variable costs. Let

p = price charged per unit sold

c = variable cost of each unit produced

F = fixed cost per year

Q = number of units produced and sold per year.

The **variable cost**, c, is the portion of the total cost that varies directly with volume of output. This cost includes costs per unit for materials, labor, and usually some variable part of overhead. The **fixed cost**, F, is the portion of total cost that remains constant regardless of changes in levels of output. This cost represents the annual cost of new equipment and facilities purchased (or rented) for the new product or service, including depreciation, interest, taxes, and insurance. The fixed cost can also cover salaries, utilities, and portions of the sales or advertising budget. The difference between the price and the variable cost of each unit is often called the unit profit margin ($p - c$) because it contributes both to profits and to meeting fixed costs.

Let's assume that the cost function is linear and consists of the fixed cost plus total variable costs ($F + cQ$). If we set total annual revenues (pQ) equal to the total cost and solve for Q, we get the break-even quantity:

$$pQ = F + cQ$$
$$(p - c)Q = F$$
$$Q = \frac{F}{p - c}$$

We can also find this break even quantity graphically, as shown in the following application. It is the point where the total revenue line crosses the total cost line.

Application 3: Finding Break-Even Quantity

A hospital is considering a new procedure to be offered at $200 per patient. Fixes cost per year would be $100,000, with total variable cost set at $100 per patient. What is the break-even quantity for this service? Use both the algebraic and graphic approaches to get your answer.

Solution

For the hospital to break even, the number of patients (Q) must equal the fixes cost per year (F) divided by the unit profit margin (p-c). Thus using the formula for the break-even quantity, we get

$$Q = \frac{F}{p - c} = \frac{100,000}{200 - 100} = 1000 \ patients$$

The graphic procedure requires that we plot two lines – one for costs and one for revenues. We begin by calculating costs and revenues for two different output levels. The following table uses Q = 0 and Q = 2000, although any two reasonably spread out output levels are equally good.

Quantity (patients) (Q)	Total Annual Costs ($) (100,000 + 100 Q)	Total Annual Revenues (4) (200Q)
0	100,000	0
2000	300,000	400,000

Since two points define a line, we can now drew the cost line through points (0; 100,000) and (2000;300,000). The revenue line goes between (0;0) and (2000;400,000). As Figure 3 indicates, these two lines intersect at 1000 patients, the break-even quantity.

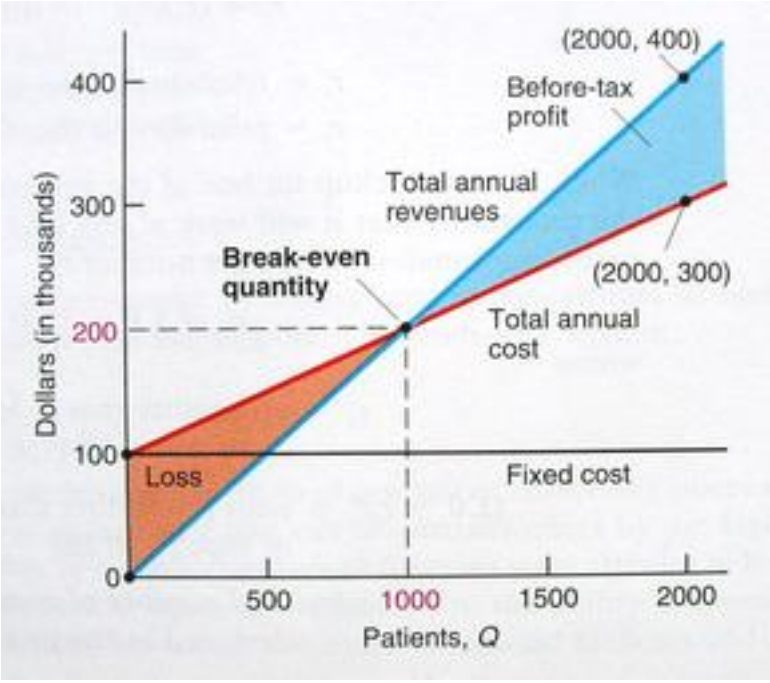


Figure 3 Graphic Approach to Break-Even Analysis

Break-even analysis cannot tell a manager whether to pursue or drop a new product or service idea. The technique can only show what is likely to happen for various forecasts of costs and sales volumes. Fortunately, we can go beyond simple break-even analysis and work directly with the underlying cost and revenues equations to evaluate a variety of "what if" questions. This approach is called **sensitivity analysis**, a technique for systematically changing the critical parameters in a model to determine their effects. With product and service planning, we can assess the sensitivity of total profit to different pricing strategies, sales volumes forecasts, or cost estimates.

Application 4: Sensitivity Analysis on the Sales Forecasts

If most pessimistic sales forecast for the proposed service in Figure 3 were 1500 patients, what would be the procedure's total profit contribution per year?

Solution

The graph shows that even the pessimistic forecast lies above the break-even volume, which is encouraging. The product's total profit contribution, found by subtracting total costs form total revenues, is

$$pQ - (F = cQ) = 200 \times 1500 - (100{,}000 + 100 \times 1500) = \$50{,}000$$

Reliability Analysis

Products or services often consist of a system of components that must all be operative to be effective. Sometimes products of services can be designed with extra components (or subsystems) so that if one component fails, another can be activated. This type of design increases the reliability of the product or service, which is the probability that the system or one of its components will work at any time. Without backups, all components must work for the entire system to work. The reliability of a system with *n* different components is

$$r_s = r_1 \times r_2 ... \times r_j \times ... \times r_n$$

Where

r_s = reliability of the system

r_j = reliability of *j*th component

When there is backup for one of the components, say the *j*th component, or the probability that it will work at any time, then r_j must be replaced in the preceding equation by a larger number r'_j:

$$r'_j = 1.0 - (1.0 - r_j)^m$$

Where

r'_j = probability that at least one of the m components of type *j* will work at any time

$(1.0 - r_j)^m$ = joint probability that all *m* components of type *j* will fail.

Application 5: Calculating a Product's Reliability

A new machine being designed has three basic components, with individual reliabilities of 0.78, 0.99 and 0.95, respectively. What is the machine's reliability with no backups? What is its reliability with tow backups (a total of three units) of the first component?

Solution

The machine's reliability without backups is only 0.73, or significantly less than that of the individual components:

$$r_s = 0.78 * 0.99 * 0.95 = 0.73$$

When two backups are added for the first component, the machine's reliability increases to 0.93:

$$r_s = [1.0 - (1.0 - 0.78)^3] * 0.99 * 0.95 = 0.93$$

2.2. COMPETITIVE PRIORITIES

As important as choosing a product or service is deciding how to excel in producing or delivering it. For example, it is not enough to decide which types of food to offer at a new restaurant. The owner must also determine the restaurant's distinctive competencies, such as its location or distinctive cuisine. By taking advantage of them, the owner can set the restaurant apart from its competitors. **Competitive priorities** are the dimensions that a firm's production system must possess to support the demands of the markets the firm wishes to compete in. There are 8 dimensions, which fall into four groups:

Cost

1. Low cost

Quality

2. High-performance design
3. Consistent quality

Time

4. Fast delivery time
5. On-time delivery
6. Development speed

Flexibility

7. Customization
8. Volume flexibility

A firm gains an advantage by outperforming competitors on one or more of these dimensions with the support of its production system.

Cost

Often firms compete on the basis of low prices. Lowering prices reduces unit profit margins, an outcome that can be partially offset by the higher volumes that may follow. The firm's operations function must attempt to lower the cost of labor, materials, scrap, and overhead. But the ability to lower costs often requires additional investment in more automated facilities and equipment. Lowering prices to maintain or increase market share, and reducing costs without jeopardizing quality, usually occurs with undifferentiated products in the maturity stage of their life cycle. At that stage output levels tend to be high, equipment is specialized, and efficiency is likely to be at a peak. In the context of break-even analysis, the fixed cost, *F*, is increased to achieve a sharply reduced variable cost, *c*.

Quality

Two competitive priorities deal with quality. The first one, **high performance design**, can mean superior features, close tolerances, and greater durability. It also includes the helpfulness and skill of the work force, whether sales clerks or service station attendants. After-sale support and financing may also be part of the design specifications. For example computer companies may offer installment payment plans, credit cards, and equipment leasing, which may lead to a big boost to sales.

The second competitive priority is consistent quality. It measures the frequency with which the product or service meets design specifications. A foundry might measure the percent of castings falling within the tolerances allowed for length, diameter, and surface finish. A bank might measure the number of errors made recording customer account numbers by its booking services department.

Time

Three competitive priorities deal with time. The first, **fast delivery time**, is the elapsed time between receiving a customer's order and filling it. Industrial buyers often call this *lead time*. An acceptable delivery time can be a year for a major customized machine, several weeks for scheduling elective surgery, and minutes for and ambulance. Firms can shorten delivery times by producing to inventory or having slack capacity.

The second time priority reflects variability in deliver time, rather than its average. **On-time delivery** measures the frequency of meeting deliver-time promises. Manufacturers measure on-time delivery as the percentage of customer orders shipped when promised, with 95% often considered the goal. A supermarket might measure on-time delivery as the percentage of customers who must wait in the checkout line for less than tree minutes.

The third time priority, **development speed**, measures how quickly a new product or service is introduced, covering the elapsed time from idea generation through final design and production. In industries where life cycles are short, development time becomes critical. Companies have to respond quickly to each new product or service that enters the market. Getting the new product or service to market first gives the firm an edge on the competition, which is difficult to overcome when the business environment changes so rapidly. But one size does not fit all. Development speed is less important when R&D costs are high and technology and customer preferences are highly uncertain.

Flexibility

Some firms give top priority to one of two types of flexibility. **Customization** is the flexibility of the firm to accommodate the unique needs of each customer and ever-changing product designs. Products or services are tailored to individual preferences or have very short life cycles. Volumes for any given product or service are low because the firm competes on the basis of its ability to produce difficult, nonstandard items. The extreme case is one-of-a kind production, where each new order is unique.

Volume flexibility, on the other hand, is the ability to quickly accelerate or decelerate the rate of production to handle large fluctuations in demand. The time between peaks can be years, as with the cycles in the home-building industry or political campaigns. It can be months, as with a ski resort. It even can be hours, as with the systematic swings in demand from hour to hour at major postal facility where mail is sorted and dispatched.

Trade-offs

Sometimes a firm can improve cost, quality, and flexibility simultaneously. For example, scrap and rework sometimes accounts for 20-30% of a products cost. By reducing scrap and rework the firm can sharply reduce costs, improve productivity, and reduce delivery time. Improving the quality of products and services can help stimulate sales to the point where high-volume production is possible. An underlying factor here is repeatability, the degree to which the same work can be repeated through job specialization or by producing standardized products and services. Increased repeatability reduces unit costs, permitting production of a higher-quality product or services at lower prices. Thus improved quality might actually be cost-free.

Unfortunately, at some point further improvements on one dimension are accompanied by setbacks on one or more of the other. For example research shows that high customization leads to both higher costs and prices. This trade-off with costs, however doesn't always occur. For example, broader product lines and extensive variety through standard options can be achieved without sacrificing high-volume production. Another example of trade-offs is the top-of-the-line specifications of Rolls Royce, which make premium prices necessary. And delivery times are also slower because the painstaking hand assembly process means it still takes six months to build a car.

Thus managers must recognize the trade-offs that exist among the eight competitive priority dimensions. Because much depends on the exact situation, managers must judge trade-offs outcomes when deciding which dimensions need particular emphasis. For example, low customization like that at McDonald's allows a fast, mass-production process. C. Hoare & Company enhances its top-quality image by also having fast delivery times, as by answering loan inquiries the day they are received. Moreover, the resulting increase in the price of the service provided is of little concern to the bank's customers.

Setting Competitive Priorities

It is intriguing to see how executives in the US rate the competitive priorities for their businesses. In one survey, executives judged the importance of each competitive priority to their firms. As expected, each priority was rated by the average respondent to the quite important. To focus on the relative rankings, however, Figure 4, shoes

the difference between a priority's average and the grand average calculated for all 8 priorities. Positive values mean that the priority is more important, and negative values mean the priority is less important. On-time delivery and consistent quality emerged at the top, eith high-performance design placing third and trice next. The last two dimensions of time and the two flexibility priorities came in last. The most marked shift, compared to the previous survey, was in low price, made possible by low-cost operations. Price increased by almost 10% in importance.. As customers seek the best value for their dollar outlays, price increasingly enters their purchasing decision.

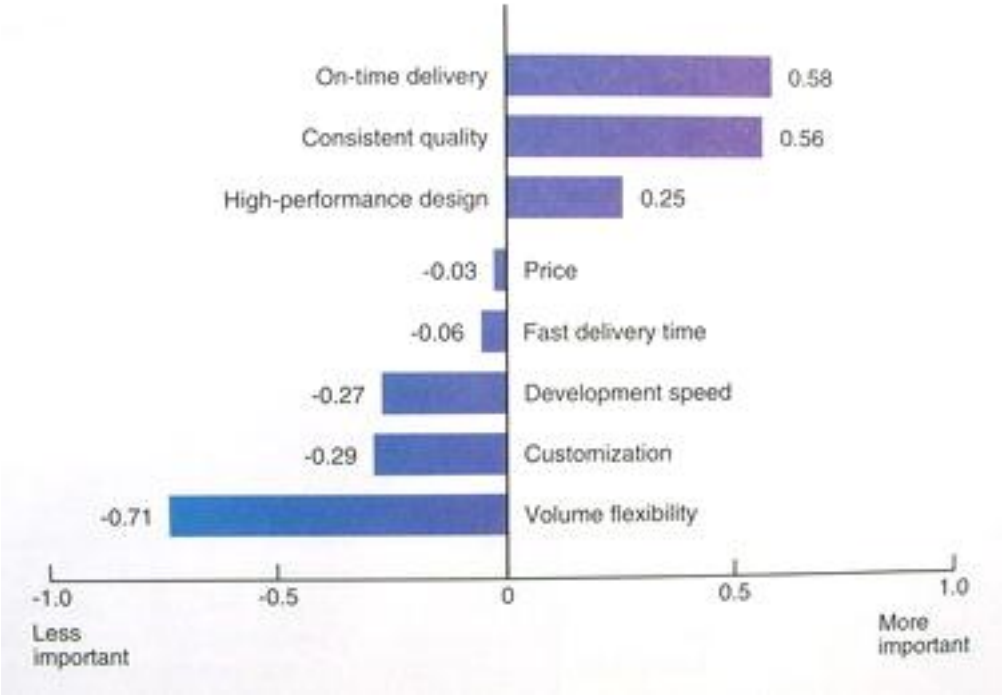


Figure 4 Competitive Priorities of U.S. Manufacturers

Effective operations strategy begins with periodic reviews of competitive priorities. Managers should assess the firm's current performance in terms of the desired level on all 8 dimensions. Performance should also be judged against the industry norm. Finally, the managers set specific, measurable standards. Examples of such standards for each competitive priority include the following:

- Reduce the cost of $10 per unit.
- Decrease scrap losses by 10%
- Maintain the current tolerances for product weight.
- Promise deliveries within three weeks after receiving an order.
- Improve on-time delivery to 95%.

- Cut the development and testing time for a new service by 6 months.
- Increase the number of product options by 50%
- Be able to double the production rate in just two months.

2.3. TIME BASED COMPETITION

As we've seen in Figure 4, managers rank on-time delivery as one of the most important competitive priorities. Indeed, three of the top five competitive priorities are related to time-based competition. Life cycles are shrinking quickly – especially in Japan. A European car has a model-life of 12 years, while a Japanese car's life is less than 5 years and falling. By some estimates the Japanese bring out a new product in half the time as it takes their U.S. competitors and one-third the time it takes the Europeans. This ability allows a firm to abandon today's new product or service more quickly, making it stronger and more profitable tomorrow. In response many companies are putting particular focus on the competitive priorities of development speed and fast delivery time. With **time-based competition**, managers carefully define the steps and time involved to deliver a product or service and then critically analyze each step to see whether time can be saved without compromising quality. Managers seek fundamental changes that save time – from product or service development, order entry, production, and distribution. Significant time reductions in operations can often be achieved by changing the way current technologies are used or by turning to automation. Concurrent engineering can also speed up the development time because of every-body's early involvement and simultaneous ownership of the product or service design.

Reducing Response Time

Atlas Door gained the number one competitive position in an industry previously dominated by large, established firms by focusing on fast delivery times. Atlas makes industrial doors, a product with limitless options in width, height, and material. It reorganized its factories to allow for a uniform flow of products, thereby reducing the manufacturing time of each product. It also streamlined and automated order-entry, engineering, pricing, and scheduling processes. Atlas can schedule and price 95% of telephone orders while the caller is still on the line. Finally, Atlas developed a system to ensure that all parts necessary for shipment to a construction site would be available at the same time. As a result, Atlas can respond to an order in a few weeks:

the industry average is 4 months. This quicker response time allows Atlas to charge premium prices. Because its time-efficient processes yield lower manufacturing costs, it also enjoys big profits. Atlas's competitors did not recognize the thrust of the time-based strategy and still think it will gravitate to the industry averages as volume increases. However, the enormous lead that Atlas presently enjoys will be very difficult, perhaps impossible to overcome.

More products in less time

Another example of time-based competition is Honda's response to Yamaha's attempt to take over a larger share of the motorcycle market (Stalk, 1988). Honda changed its methods for developing, manufacturing, and introducing new products to enable it to speed up execution of new product plans. Within 18 months it introduced or replaced 113 models, while Yamaha could manage only 37 changes in its product line. Honda's strategy caused its sales to soar. The devastating defeat of Yamaha was a clear warning to Suzuki and Kawasaki not to challenge Honda's leadership. Clearly Honda had used time to its competitive advantage.

2.4. POSITIONING STRATEGIES

For given product and service plans, and their accompanying competitive priorities, the operations manager must select a **positioning strategy**. This choice determines whether the production system will be organized by grouping resources around the process or around the product or service.

Firms using a **process-focused strategy** tend to produce a wide range of customized products or services. The operations manager sets aside a singly are for each process (such as drilling or welding on manufacturing or accounts payable in a service firm's accounting department), and various products move from one process to another. Different types of machines or works are grouped together to handle all products or services requiring a specific function. All products (services) needing that function are then routed to it, rather than to separated processing areas created for each one. In other words, the equipment and work force are organized around the process. With this type of strategy, products (customers) may have to compete for the same resources; as shown in Figure 5(a) products 1 and 3 must compete for the same resources at operation A, and products 2 and 3 must do the same at operation E. Note that product 1 follows an A-B-D routing pattern, product 2 follows a D-E-C

pattern, and product 3 follows and E-F-A pattern. Firms typically using a process-focused strategy include building contractors, law firms, architectural firms, and general medical practices.

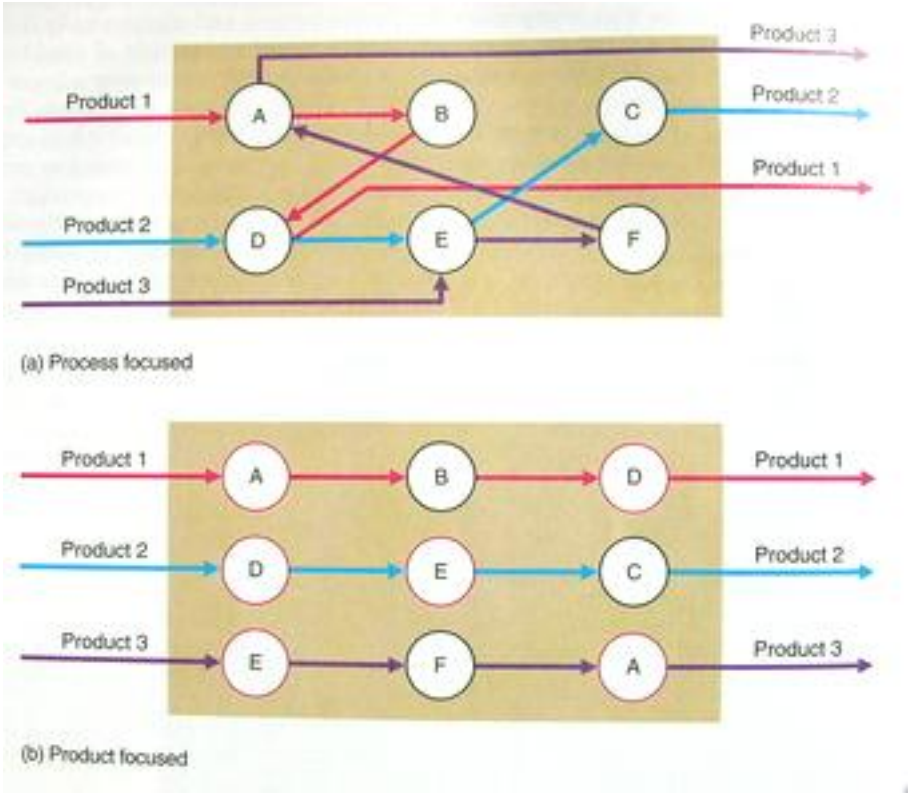


Figure 5 Two different Positioning Strategies

In the **product-focused strategy**, illustrated in Figure 5(b), the equipment and work force are organized around the product or service. This system creates duplication of operations, but products and services don't have to compete for limited resources. For example, there are two operations A in the facility, one dedicated to product 1 and one to product 3. The routing pattern for each of the three products is straightforward, with several sequential operations devoted to the same product of service. Firms typically using a product-focused strategy include automobile assembly plants, car washes, and electronic product manufacturers.

A Continuum of Strategies

Actually, firm's strategy can vary from one of its facilities to another, depending on the product or service produced at each one. Further, numerous strategies exist between the two extremes of process focus and product focus. This continuum of choices is represented in Figure 6 by the diagonal from the process focus to the product focus. The figure also shows how a manager's choice relates to volume (left

to right) and flow pattern (top to bottom). The most frequently occupied positions have the most intense color. Few firms position themselves to far outside the diagonal, the white area.

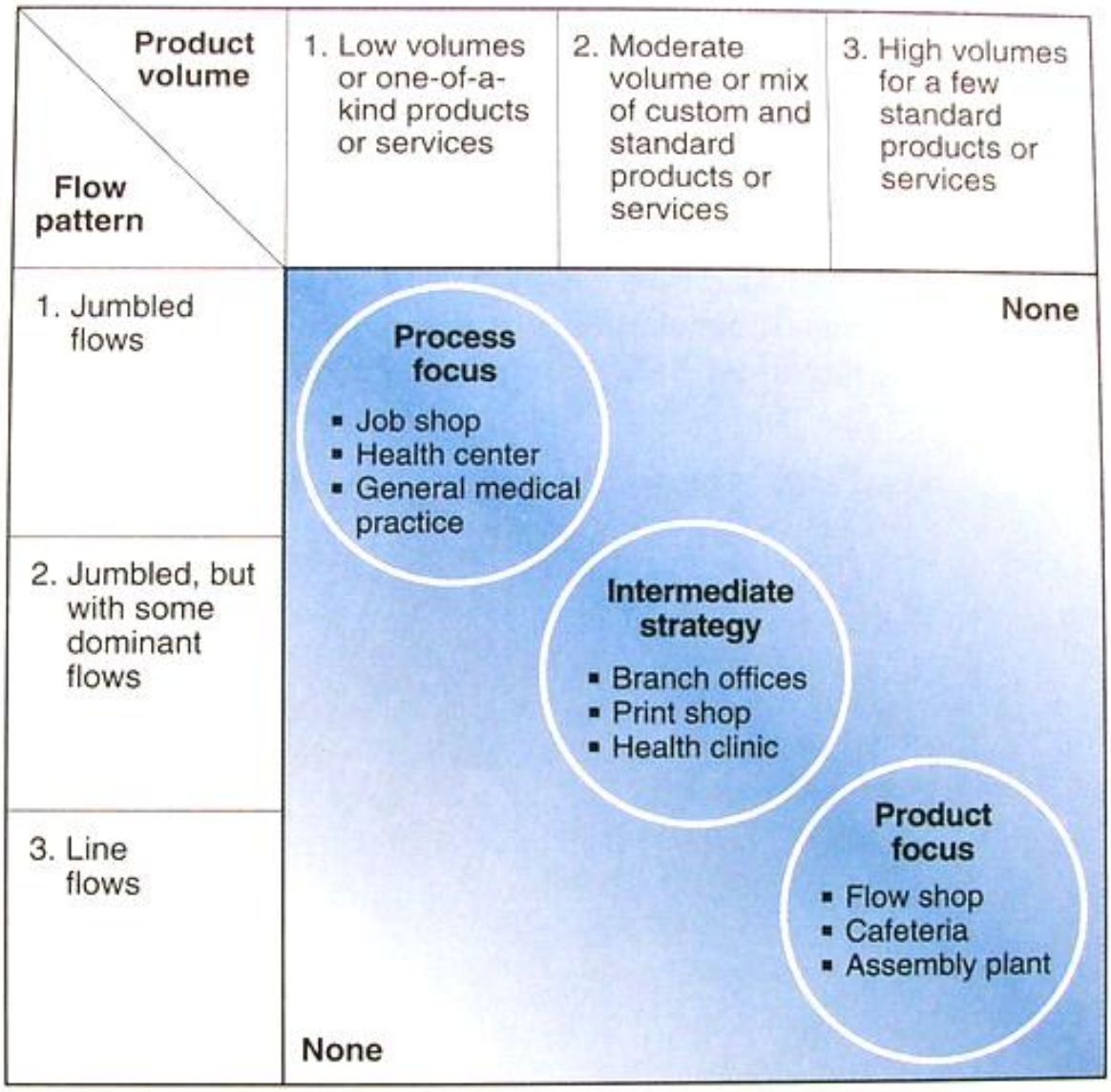


Figure 6 A Continuum of Positioning Strategies

An even more vivid depiction of choices is shown in the example of King Soopers Bakery, a division of Kroger Company with headquarters in Colorado, which illustrates three choices at work under one roof (See Supplement 1).

Process Focus

A process-focused strategy is appropriate to a firm offering a wide range of customized (made-to-order) products, *such as King Soopers' custom cake department*. In such situations product volume tends to be low, *as shown by the bar*

graph on relative volume in the King Soopers picture. If the operations manager were to dedicate resources to individual products, many operations would be duplicated and resources would often be idle. It is far more efficient to organize resources around similar processes. Because each product is unique, routings vary considerably from one order to the next. The resulting flow pattern is jumbled and unpredictable. *Compare, for instance, the complex flow in the King Soopers cake department with the linear flow in the bread line.*

A production system with a process focus is often called a **job shop**, as it takes on many types of small jobs and competes on the basis of resource flexibility. The more than 100,000 small job shops in the U.S. supply an estimate 75% of all machined metal parts used in products made by larger companies. Job shops employ the bulk of blue-collar workers.

Intermediate Strategy

Halfway between a process focus and product focus lies an intermediate strategy. Product volumes are relatively high, and batch operations can handle customer orders at the same time. If demand is sufficiently predictable, operations can produce some standardized products or components in advance of receiving actual customer orders. The flow pattern is still jumbled, but dominant paths emerge. For example, in some parts of the facility, the manager may dedicate resources to one product or a group of similar parts. Types of businesses that utilize this strategy include heavy equipment manufacturers, garment manufacturers, caterers, automobile repair shops, and small branch offices of service facilities such as brokerage firms and advertising agencies. *At Kings Soopers, the pastry lines is and example of and intermediate strategy.*

Product Focus

A product-focused strategy fits high-volume production of a few standard products, *such as bread at King Soopers*. Packaging and assembly operations often make products appear more diverse than they really are. For example, the same soft drink might be packaged in a bottle or a can. Cars on an assembly line might pass through the same basic operations, except for a blackwall or whitewall tire option. This type of production system is often called a **flow shop** because all products follow a linear routing pattern.

High volumes and product standardization allow product-focused operation to be both specialized and efficient, each task is designed with painstaking detail, and the resulting process moves along at a brisk pace. For example, a fast-food restaurant takes your order, prepares and serves your meal, and processes your payment much more quickly than does a large, expensive restaurant. Other product-focused businesses include automobile manufacturers, car washes, and electronic product manufacturers.

Line flows and high volumes lend themselves to highly automated facilities. Notice, *at King Soopers, how many more machines and fewer people the bread line uses.* Such facilities can operate round the clock to offset the huge capital investment required.

Borden's pasta making plant in St. Louis is a good example ("Borden Uses Its Noodle", 1991) It is the nation's largest pasta plant, making 250 million pounds (113 thousand tons) of pasta annually. The 300,000-square-foot (28,000-square-meter) plant is a marvel of simplicity. Grain is milled into flour at an adjacent mill and sped to the plant a few hundred meters away via giant pneumatic tubes. The flour is then distributed to one of 8 pasta-making machines, each costing $5 million and capable of producing 6000 pounds (2700 kilograms) of pasta per hour. A sophisticated touch screen computer system schedules the machines. The next step is the pressing and drying operations. The mixture finally takes shape as it is forced through large dies, some weighing more than 200 pounds (90 kilos). What comes out is one of the 65 different shapes of pasta. The product goes on to storage bins, each capable of holding 10,000 pounds (4500 kilograms) of pasta until it is ready for packaging. The plant employs only 230 workers, but at no point need the product be touched by them. Packaging is computerized, sorting 1200 different shapes and brands, putting them in the right boxes, and automatically storing them. The plant operates 24 hours a day, 363 days a year.

Positioning Strategies for Service

In the service sector, customer contact is another factor for a manager to consider when choosing a positioning strategy. Some service facilities have more face-to face customer contact than others. When service complexity is high and customer knowledge is low, service must be tailored to each customer's needs. The result is customized, low-volume production, more appropriate to a process-focused strategy. An intermediate strategy fits better when face-to-face contact and back-room work

are balanced. For example, in the front office of a bank, customer and employees interact frequently with one another. By contrast, there is little or no customer contact in the back office, where automation and batching of work increases repeatability. Other service facilities such as home offices, distribution center, and power plants, involve virtually no face-to-face contact, resulting in standardized services and high volume.

Putting It All Together

Management must link positioning strategy to competitive prioirities. In process-focused plants, the emphasis is on high-performance design (quality), customization, and volume flexibility. Low cost and quick delivery times are less important as competitive priorities. Thus a process focus meshes well with product or service plans favoring customization, short life cycles, or early exit from the life cycle. A product focus, on the other hand, is appropriate when product plans call for standard products or services and long life cycles. Low cost, quick delivery times and consistent quality are the top competitive priorities. Table 3 summarizes these comparisons.

Table 3 / Linking Positioning Strategy with Competitive Priorities

High-Level Decisions	Positioning Strategy	
	Process Focus	**Product Focus**
Product and service planning	• More customized products and services, with low volumes • Shorter life cycles • Products and services in earlier stages of life cycle • An entrance-exit strategy favoring early exit	• More standardized products and services, with high volumes • Longer life cycles • Products and services in later stages of life cycle • An entrance-exit strategy favoring late exit
Competitive priorities	• High-performance design quality • More emphasis on customization and volume flexibility • Long delivery times	• Consist quality • More emphasis on low cost • Short deliver time

As Figure 7 shows, operations managers use positioning strategy to translate product plans and competitive priorities into decisions throughout the operations function.

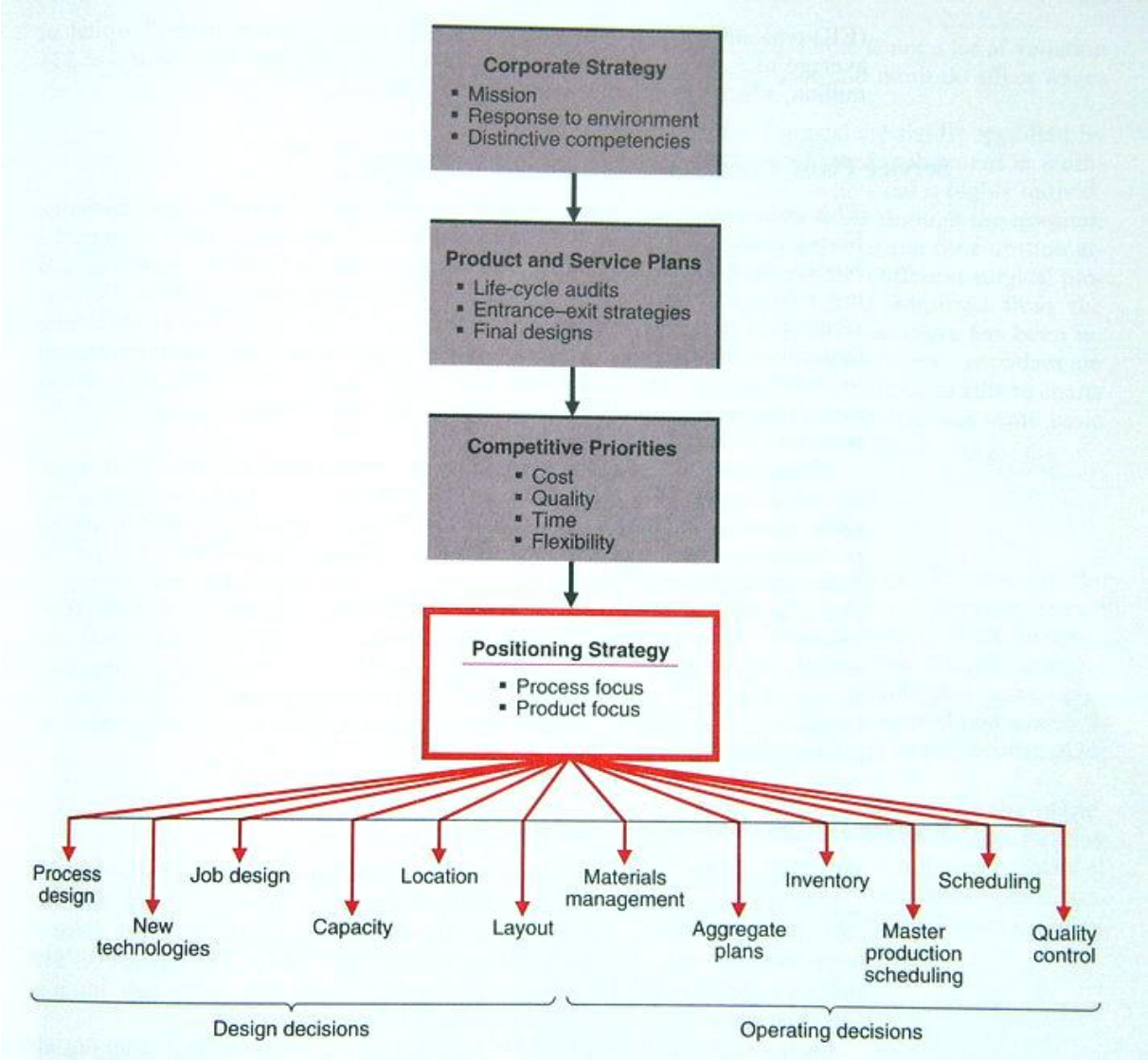


Figure 7 Positioning Strategy: The Linchpin in Operations Decisions

2.5. SOLVED PROBLEMS

Problem 1

A company is screening three new product ideas. Resource constraints allow only one of them to be commercialized. Given the performance criteria and ratings in the table, and assuming equal weights for each performance criterion, which product should management choose?

Performance Criterion	Rating		
	Product A	Product B	Product C
1. Demand uncertainty and project risk	0.3	0.9	0.2
2. Similarity to present products	0.7	0.8	0.6
3. Expected return on investment (ROI)	1.0	0.4	0.8
4. Compatibility with current manufacturing process	0.4	0.7	0.6
5. Competitive advantage	0.4	0.6	0.5

Solution

Each criterion receives 20 points (arbitrarily)

Product	Calculation	Total Score
A	20*(0.3+0.7+1.0+0.4+0.4)	= 56
B	20*(0.9+0.8+0.4+0.7+0.6)	= 68
C	20*(0.2+0.6+0.8+0.6+0.5)	= 54

The best choice is product B. Products A and C are behind in terms of weighted scores

Problem 2

The owner of a small manufacturing business has patented a new device for washing dishes and cleaning dirty kitchen sinks. Before trying to commercialize the device and add it to her existing product line, she wants reasonable assurance of success. Variable cost is estimated at $7 per unit produced and sold and fixed costs per year at $56,000.

a. If the selling price is set at $25, how many units must be produced and sold at break even? Use both the algebraic and graphic approaches.

b. Forecasted sales for the first year are 10,000 units if the price is reduced to $15. What would be the product's total contribution profits in the first year, with this pricing strategy?

Solution

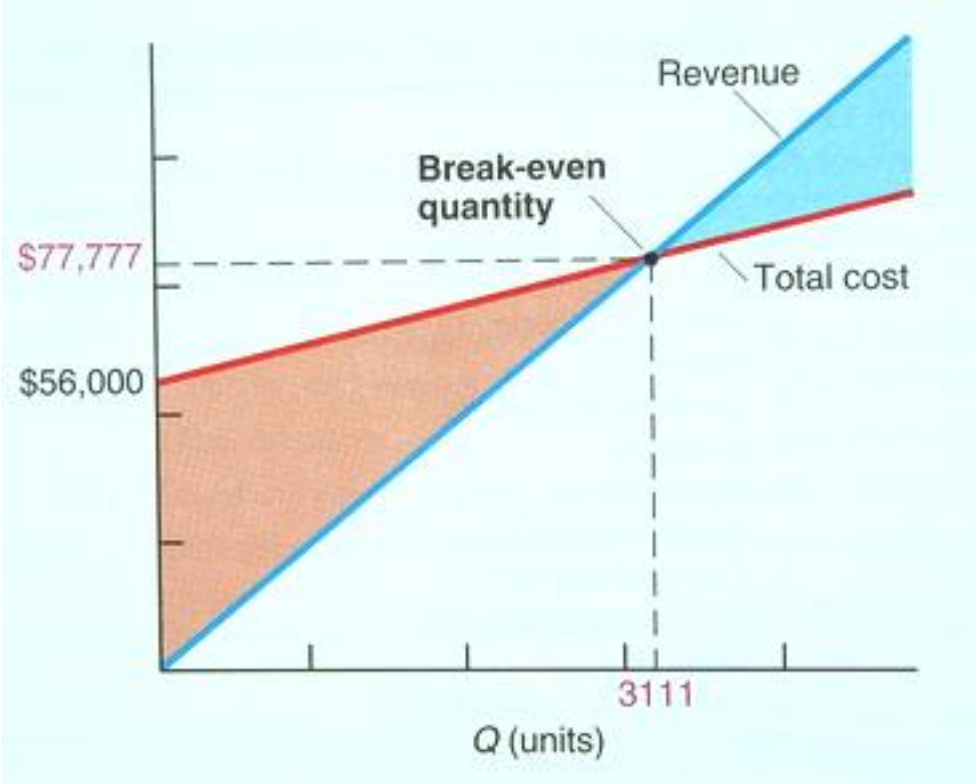
a. Beginning with algebraic approach, we get:

$$Q = \frac{F}{p - c} = \frac{56{,}000}{25 - 7} = 3111 \ units$$

Using graphic approach show in the figure below, we first draw two lines:

Total revenue = 25Q

Total Cost = 56,000 + 7Q



The two lines intersect at Q = 3111 units, the break-even quantity

b. Total profit contribution = Total Revenue – Total Cost

$$= pQ - (F + cQ)$$
$$= 15(10,000) - (56,000 + 7(10,000))$$
$$= \$24,000$$

Problem 3

A rocket has to components that can fail. The reliability of the first component is 0.80, and 0.70 for the second component. What is the reliability of the rocket is the designer provides redundancy with a backup for each component?

Solution

The reliability of the first component, when enhances with a backup, becomes

$r'_1 = 1.0 - (1.0 - 0.80)^2 = 0.96$

Similarly,

$r'_2 = 1.0 - (1.0 - 0.70)^2 = 0.91$

Therefore the whole rocket's reliability is:

$r_s = (r'_1)(r'_2) = (0.96)(0.91) = 0.87$

2.6. Formula Review

1. Break-even quantity:

$$Q = \frac{F}{p - c}$$

2. Total profit contribution:

$$pQ - (F + cQ)$$

3. Reliability:

$$r_s = r_1 \times r_2 \ldots \times r_j \times \ldots \times r_n$$

$$r'_j = 1.0 - (1.0 - r_j)^m$$

2.7. Chapter Highlights

- Product and service planning is an ongoing activity that is the starting point for designing and operating a production system.

- A life cycle consists of five stages: product/service planning, introduction, growth, maturity, and decline.
- There are three strategies for when to enter and exit the life cycle of a product/service. Each places a different demand on the production system. Entering early and exiting late forces a transition from flexibility to low cost.
- The planning steps are idea generation, screening, development and testing, and final design. These steps must fit the firm's mission, which may prove to be too narrow or too broad and have to be modified.
- Concurrent engineering involves operations and other function in developing and testing a new product or service.
- The preference matrix and break-even analysis, while not limited to product planning, are two techniques used to screen new product lines. Reliability analysis is a third technique, but its purpose is to assess how the system as a whole will perform.
- Competitive priorities state the dimensions on which the firm's production system should excel. The are eight priorities: low cost, high performance design, consistent quality, fast delivery time, on-time delivery, development speed, customization, and volume flexibility. Trade-offs among them are often necessary. Management must judge which trade-offs are best, along with the firm's distinctive competencies, when establishing desired level for each dimension.
- With time-based competition, managers seek to save time on the various steps taken to deliver a new or existing product/service.
- A process focus organizes resources around the process. This focus fits low volumes and jumbled flow patterns. A product focus organizes resources around specific products, resulting in straightforward flow patterns. It fits high volumes and standardized products.
- The more the customer contact at a service facility, the greater is the tendency toward a process focus.
- The process focus fits with low volumes, high flexibility, general-purpose equipment, labor-intensive technologies, lower capacity utilization, informal

relationships with suppliers and customers, large work-in-process inventories, and fluid schedules. The opposite is true of a product focus.

2.8. KEY TERMS

Break-even analysis	On-time delivery
Competitive priorities	Positioning strategy
Concurrent engineering	Preemptive pricing
Consistent quality	Preference matrix
Customization	Process-focused strategy
Development speed	Product and service planning
Entrance-exit strategy	Product-focused strategy
Fast delivery time	Reliability
Fixed cost	Repeatability
Flow shop	Sensitivity analysis
High-performance design	Time-based competition
Job shop	Variable cost
Life cycle	Volume flexibility
Life-cycle audit	

2.9. STUDY QUESTIONS

1. A sign on the way to an abandoned mine reads: "Choose your ruts carefully; you will be in them for the next 15 miles." How does this caution apply to product and service planning and choosing competitive priorities?
2. How does the concept of life cycles illustrate the ongoing need for product and service planning?
3. How does a decision on when to enter and exit the life cycle of a product/ service affect the operations function? With which entrance-exit strategy would a product focus make more sense?
4. The Sealtight Company is a well-diversified manufacturer in the packaging business. It makes a variety of packaging materials and sells them to industrial buyers. Management is currently conducting a life-cycle audit to identify the

current stage of each product in its life cycle. The profiles for two products are shown in the table below.

Product	Performance Measure	This Year's Performance	Change Over Last Year	Average Annual Change Over Last 4 Years
A	Annual Sales	$42.1 million	-3.1%	1.2%
	Unit Price	1.53/lb	+0.0	+0.5
	Unit Profit Margin	0.22/lb	-2.1	-0.5
	Total Profit Contribution	6.0 million	-7.4	+0.2
B	Annual Sales	$5.4 million	+72.1	+35.0
	Unit Price	1.30/lb	+7.0	+6.8
	Unit Profit Margin	0.70/lb	+12.1	+15.1
	Total Profit Contribution	2.9 million	+80.1	+37.2

a. In which stage is product A? Product B? Explain your answers
b. For which product would low price be a higher competitive priority? Why?

5. Give and example of each component of the "service bundle" for each of the following products.
   a. An insurance policy
   b. An airline trip
   c. Dental work

6. What dimensions of competitive priorities seem to be the most important for each of the following companies?
   a. McDonald's
   b. Toyota
   c. A manufacturer of specialty glues tailored to the needs of industrial buyers in the furniture and mobile-home industries.

7. Explain how time-based competition can be used to gain a market niche.

8. What positioning strategy (process focus or product focus) seems best for each of the following types of companies? Briefly defend your choice.

a. A builder of skyscrapers and bridges
b. A paper mill
c. A microwave manufacturer
d. A manufacturer of a wide variety of men's suits

9. Why do firms offering more customized, low-volume products tend to
    a. Compete less on short customer delivery times and low costs?
    b. Be less capital intensive?
    c. Maintain larger capacity cushions?

10. Why do firms with product focus tend to
    a. Plan production and inventory levels further into the future?
    b. Have more formalized supplier relationships?
    c. Concentrate inventory less at the work-in-process level?

11. Two forces are at work in the health-care industry. First, there is pressure to make heavy investments in new equipment to keep up with rapid advances in technology. Second, there is pressure for shorter patient stays and more outpatient treatment, thereby helping curb escalating health costs. Use break-even analysis to describe how these forces change fixed costs, break-even inpatient volumes, and the financial position of the typical hospital.

2.10. PROBLEMS

Problem 1

The Foresite Company is screening three ideas for new services. Resource constraints allow only one idea to be commercialized at the present time. The following estimates have been made for the five performance criteria that management feels are most important.

Performance Criterion		Rating		
		Service A	Service B	Service C
1.	Capital Equipment investment required	0.6	0.8	0.3
2.	Expected Return on Investment (ROI)	0.4	0.6	0.9
3.	Compatibility with current work-force skills	0.4	0.7	0.4

4.	Competitive advantage	1.0	0.4	0.6
5.	Compatibility with EPA requirements	0.2	1.0	0.2

Questions:

a. Calculate total weighted score for each alternative, using a preference matrix and assuming equal weights for each performance criterion. Which alternative is best? Worst?

b. Suppose that the expected ROI is given twice the weight assigned to each of the remaining criteria. Does this affect the ranking of the three candidate services?

Problem 2

You are in charge of analyzing five new product ideas and have been given the information shown in table below

Performance Criterion		Rating (1=worst; 10 = best)				
		Product A	Product B	Product C	Product D	Product E
1.	Compatibility with current manufacturing processes	8	7	3	6	8
2.	Project risk	3	8	4	7	7
3.	Market potential	7	5	7	6	2
4.	Unit project margin	7	6	9	1	6

- Management decided that criterion 2 and criterion 3 are equally important, criterion 1 is five times as important as criterion 2, and criterion 4 is three times as important as criterion 2.
- Only two new products can be introduced.
- A product can be introduced only if it exceeds 70% of the total possible points

Questions:

a. What are the weights on the criteria if they must sum 100?

b. What is the threshold on weighted scores?

c. Which product ideas do you recommend?

Problem 3

Buzzrite Corporation is considering the introduction of a new lightweight chain saw to broaden its line of home-use products. The R&D department has developed two prototypes – a gasoline-powered model A and an electric powered model B. Dew to constraints, Buzzrite can introduce only one of the models, and management is debating which model to bring to market. The following performance criteria have been estimated to evaluate the two products.

Performance Criterion		Rating	
		model A	model B
1.	Capital Equipment investment required	0.5	0.6
2.	Expected Return on Investment (ROI)	0.7	0.5
3.	Similarity to present products	0.4	0.3
4.	Competitive advantage	0.3	0.6
5.	Energy efficiency	0.6	0.4

Questions:

a. Calculate a total weighted score for each alternative, using a preference matrix and assuming equal weights for each performance criterion except ROI, which is twice the weight of any of the others.

b. If ROI is 3 times and competitive advantage is 2 times the weights of the other criteria, what will be the total weighted score for the two products?

Problem 4

Mary Williams, owner of Williams Products, is evaluating whether to introduce a new product line. After thinking through the production process and the cost of raw materials and new equipment, Williams estimates the variable cost of each unit produced and sold at $5 and the fixed cost per year $42,500.

Questions:

a. If the selling price is set at $16, how many units must be produced and sold to break even? Use first graphic and then algebraic approaches to get your answer.

b. Williams forecasts sales of 7000 units for the first year if the selling price is set at $12.50. What would be the total contribution to profits from this new product during the first year?

c. If the selling price is set at $11, Williams forecasts that first-year sales would increase to 10,000 units. Which pricing strategy ($11 or $12.50) would result in the greatest total contribution to profits?

d. What other considerations would be crucial to the final decision about making and marketing the new product?

Problem 5

A product at the Jennings Company has enjoyed reasonable sales volumes, but its contributions to profits have been disappointing. In 2004, 17,500 units were produced and sold. The selling price is $22 per unit, variable costs – $18, and fixed costs – $80,000.

Questions:

a. What is the break-even quantity for this product? Use first graphic and then algebraic approaches to get your answer.

b. Jennings is considering ways to either stimulate sales volumes or decrease variable costs. He feels it is possible to increase sales by 30% or reduce c to 85% of its current level. Which alternative leads to higher contributions to profits, assuming that each is equally costly to implement?

c. What is the percentage change in the unit profit margin generated by each alternative in part (b)? How does this explain the result you obtained in part (b)

Problem 6

The Franklin Electronics Company is a small manufacturer of electronic products. Its executive committee is considering the possibility of introducing a novelty MP3 player. The production department estimates that buying the necessary equipment would increase fixed cost per year by $20,000, The accounting department projects that the product would have to absorb another $20,000 for the additional costs of executive salaries, rent, and taxes. The marketing department believes that the initial advertising budget would have to be $35,000 per year and that its sales budget would increase by another $40,000 per year. The new product would be priced at $30 F.O.B. factory with no quantity discounts. The various operating departments expect to variable cost for labor and materials to be $20 per unit.

Questions:

a. How many units must be produced and sold for the company to break even?

b. If the advertising budget were increased to $45,000, what would be the break-even quantity?

c. A more automated production process could be used. It would double production's fixed costs, while reducing the total variable cost per unit from $20 to $14. Would this more advanced technology decrease or increase the break-even quantity? Must this always be the case?

Problem 7

John Anderson, vice president of Tri-Arrow Enterprises, has the folloing estimates of production and sales for the upcoming year on of Tri-Arrow's products:

Expected Sales = 15,000 units

Fixed Cost = $280,000 /year

Variable Cost = $100 /unit

Selling price = $125 /unit

Questions:

a. What is the expected contribution to profits of this product for the upcoming year?

b. Anderson believes that variable costs may increase because of an increase in raw-material costs. By how much can variable costs increase and still allow this product to positively contribute to profits for the next year?

c. Anderson believes that fixed cost can be reduced by decreasing the projected marketing budget (with no ill effect on expected sales). If variable costs increase by the amount calculated in part (b), by how much would fixed costs have to decrease to achieve the contribution to profits originally projected?

Problem 8

Tron Audio Products is planning to introduce a new model of DVD player. To produce the new player, Tron will have variable manufacturing costs of $72 per unit, fixed costs of $225,000 a year, and a one time initial investment cost of $110,000 for new manufacturing equipment, with no salvage value at the end of the product cycle. Tron predicts a four-year life cycle for the new player. The selling price to distributors will be $145.

Questions:

a. How many players must be sold the first year to reach the break-even point if the initial cost of the new manufacturing equipment is to be fully recovered during the first year? Use first graphic and then algebraic approaches to get your answer.

b. Tron believes it will sell 4000 units the first year, 7000 units yearly for the second and third yeas and 3500 units the fourth year. If sales and fixed costs are constant throughout each year, how long will it take before Tron begins to show a profit from the new player. For this problem ignore time value of money.)

c. Based on the above information, should Tron introduce this new model?

Problem 9

Clips, Inc., a retail office-supply products chain, is planning to open retail computer centers in each of its ten stores. While they will carry several models selling at different prices, the average model will cost them $1800 and will sell for $2295. Additional fixed costs incurred by each store will be $114,000 yearly, and Clips estimates that it will spend an additional $250,000 at the corporate level for marketing and other activities related to the computer centers.

Questions:

a. Using both the graphic and the algebraic methods, calculate the break-even point for Clips, Inc., based on the average cost and sales price.

b. What will be the average number of computers sold per store for each store to realize a $100,000 after all store and pro rata share of corporate costs have been accounted for?

Problem 10

The Medfield Bike and Ski Company is introducing a new service at its store. The owner estimates that the variable cost of each customer serviced will be $30 and annual fixed costs, $15,000. Sales for three different pricing strategies are forecasted as follows.

Pricing Strategy	Slaes Price ($/Customer)	Demand (customers per year)
A	75	2000
B	100	1250
C	125	1000

What pricing strategy would bake the greatest contribution to profits?

Problem 11

A new service can be sold for $12 per client. It costs $7 (unit variable cost) to provide theis service on a new piece of equipment. If the break-even quantity is 10,000 clients per year, what must be the annual fixed cost to acquire the equipment?

Problem 12

A restaurant is considering adding to its menu a new item that will require $45,000 in fixed costs per year. Variable costs are estimated to be $12.75. The firm wants to break even if 8000 units are produced and sold per year. What should be the price of the new item?

Problem 13

A semiconductor has three components. Component 1 has reliability of 0.98, component 2 – 0.95; and component 3 – 0,85.

Questions:

a. What is the reliability of the semiconductor?

b. If two backups are provided for component 2, and three backups for component 3, what is the reliability of the new system?

Problem 14

An intricate part on an amusement park ride has a reliability of only 0.70, despite all engineering efforts to increase it. If redundancy is provided with four backups, giving the total of five replicates, what is the part's reliability?

Problem 15

Mellissa Graham has the following data concerning the production of one of her company's best selling products, the Electrotype typewriter. All dollar amounts are in 1989 dollars (to adjust for inflation).

Questions:

a. Determine the break-even quantity using the graphic approach.

b. Assume that the data from 1989 and 1990 are most representative of the Electrotype operation. What are the annual fixed costs and the variable cost per unit? Hint: solve the following two linear equations for the tow unknowns.

F + c(1000) = $100,000

F + c(1500) = $140,000

Problem 16

The following information is available about a service that Highlife Company whishes to introduce.

- The expected life span of the service is five years. The projected annual demand (in customers) for next five years is 11,000, 16,000, 17,000, 24,000, and 10,000 respectively.
- The selling price is $8 and the variable cost per unit is $6.
- The tax rate is 40%.
- The desired rate of return is 13%. The initial investment for this product is $40,000 and the salvage value of the equipment is $5000.
- Assume straight-line depreciation.

Questions:

a. Determine the incremental after-tax cash flows attributed to this service over its life.

b. Should this service be accepted using the NPV method of analysis?

c. If management has set a payback period of three years, should the service be accepted?

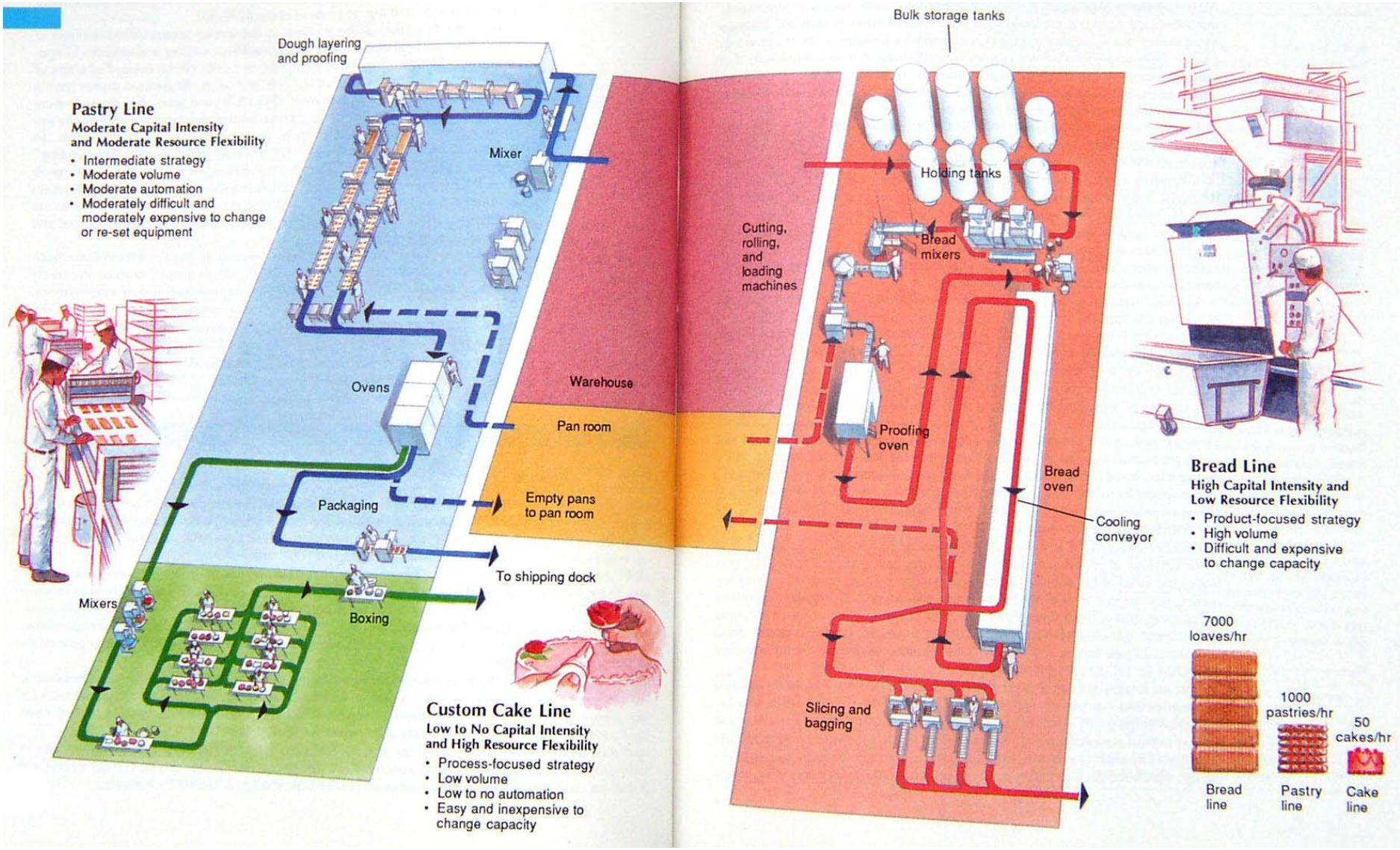
d. What does your answer in part (c) tell you about using the payback period as a method of evaluation?

2.11. Sources and References

1. Skinner, Wickham. *Manufacturing in the Corporate Strategy.* New York: John Wiley and sons, 1978.

Terms	Synonyms	Meaning
Lb	*from Latin* "libra(e)" – pound(s)	фунт(ы)

Supplement 1 Process Flow at Kings Soopers Bakery (3 in 1)


Pastry Line
Moderate Capital Intensity and Moderate Resource Flexibility
• Intermediate strategy
• Moderate volume
• Moderate automation
• Moderately difficult and moderately expensive to change or re-set equipment
Dough layering and proofing
Mixer
Ovens
Packaging
Mixers
Boxing
To shipping dock
Warehouse
Pan room
Empty pans to pan room
Custom Cake Line
Low to No Capital Intensity and High Resource Flexibility
• Process-focused strategy
• Low volume
• Low to no automation
• Easy and inexpensive to change capacity
Bulk storage tanks
Holding tanks
Bread mixers
Cutting, rolling, and loading machines
Proofing oven
Bread oven
Cooling conveyor
Slicing and bagging
Bread Line
High Capital Intensity and Low Resource Flexibility
• Product-focused strategy
• High volume
• Difficult and expensive to change capacity
7000 loaves/hr
1000 pastries/hr
50 cakes/hr
Bread line
Pastry line
Cake line