Agroindustrial Investment and Operations

James G. Brown

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Foreword

Agroindustry—that is, industry based on the processing of agricultural raw materials—is vital to the economies of developing countries. In some instances, the processing is required to prepare a primary product for domestic or foreign trade. In others, it offers a means of increasing the domestic value of a raw material. Agroindustry also helps developing countries meet the growing demand for processed foods that tends to spring up in the wake of rising incomes and spreading urbanization. Consideration of these issues led the Economic Development Institute (EDI) of the World Bank in 1974 to initiate courses in agroindustrial projects for planners from the developing world. From the material he had prepared for these courses, James Austin wrote his successful book, *Agroindustrial Project Analysis*, published by the Johns Hopkins University Press in 1981.

During the 1980s, James Brown, at that time agroindustries adviser in the World Bank, directed the preparation of a series of profiles on a wide range of agroindustries; these are available in the informal EDI Working Paper Series. He also began writing an associated book during this period.

In 1988, J. A. Nicholas Wallis, chief of EDI’s Agriculture and Rural Development Division, recognized that the time was ripe for James Austin to revise his book and that the book by James Brown could be a useful complement to the second edition of Austin’s analysis. It was therefore planned that Brown’s book would focus on the management and finan-
cial aspects of agroindustries as autonomous enterprises in a market-oriented economy.

With the financial support of the Canadian International Development Agency (CIDA), the management consulting firm of Deloitte & Touche worked with James Brown to complete this book. Two members of Deloitte & Touche, David Hughes and Fred Mooney, were the principal authors of chapters 2 and 5, respectively. Lucia Frick made important contributions to chapter 5. Aiden Gulliver coordinated the efforts of the Deloitte & Touche team.

This book is intended to be a practical guide to the management of agroindustrial investments in developing countries. It should be of use to trainers in need of comprehensive teaching material focused at the enterprise level, the staff of development banks and other credit institutions seeking guidelines on appraisal and supervision, and private sector investors needing a framework for feasibility studies and operational planning, particularly for projects in developing countries.

This book is one of a number published by EDI that arise from the training activities of the Institute. We hope that making these publications available for wider circulation will help those new to agroindustries and management and those responsible for training to understand relevant analytical techniques that can lead to more efficient agroindustries.

Amnon Golan, Director
Economic Development Institute
The World Bank
Introduction

More than half of the manufacturing activity in the developing countries of the world consists of agroindustry—of preserving and transforming agricultural raw materials. In its rudimentary form, agroindustrial processing is one of the first steps on the road to industrialization. Even a village with a small rice mill or an oilseed press can be said to be in the early stages of industrialization.

As the domestic economy develops, disposable income and urban population grow and create markets for a greater volume and diversity of processed goods. When farm incomes rise and labor productivity increases, more and more production capacity can be diverted from agriculture to meet this new demand. Prepared foods such as bread, tortillas, and processed cassava quickly become standard items in urban and even rural diets. Canned goods such as tomato paste, condensed milk, and tinned fish find their way into village stores and weekly markets in the most remote regions. If these goods are imported, they usually came from a somewhat more developed neighboring country, not a fully industrialized economy.

The expansion and deepening of the economy coincide with changes in export trade, and agroindustrial activity enters a new phase of development: An increasing share of its output takes the form of semiprocessed goods that become inputs to yet other industrial processes. Some intermediate goods—such as tanned leather and spun cotton—emerge from traditional crafts, and industrialization simply standardizes and increases the scale of the processing. Others are the result of processing
activities that develop in response to technological innovation, as rubber processing did following the automotive revolution. The technical skills and industrial work habits that take shape in these industries eventually find application elsewhere in the economy. Consequently, the manufacturing and service sectors begin to broaden, setting the stage for a gradual decline in the relative importance of agroindustry, which gathers momentum as other activities surpass the sector in terms of share of gross domestic product (GDP).

Further along on the development path, agroindustrial processing for export and domestic markets evolves to secondary and tertiary stages, as enterprises and governments try to capture an increased share of the value added and employment in the finished product. At this stage of development, agroindustry exhibits increasing levels of technology and capital intensity in the value of its production, and declining shares of local raw material and unskilled labor. It offers a wide range of outputs for both domestic and export markets, and for industry and consumers, but it also begins to lose the competitive advantage inherent in its earlier stages of development, when it was transforming local materials with local skills. This maturing agroindustry will now find itself competing with other suppliers for markets at an international level, and it will also have to compete with other sectors of the economy for capital, labor, and natural resources.

The pattern just described is, of course, a very generalized one. In practice there are many variations among industries and countries. However, most agroindustries have certain basic elements in common and they pass through similar stages of development. The challenge to investors and economic planners alike is to identify opportunities for viable postharvest investment, and to provide the design and the policy environment that will make it possible for the development process to continue.

When *Agroindustrial Project Analysis*, by James Austin, was first published in 1981, it met with widespread appreciation for the conceptual framework and practical orientation it offered to those engaged in agroindustries and economic development. It quickly became a standard reference for project design in the context of economic development. In the second edition of his book (1992), Austin incorporated conceptual developments of the preceding decade and discussed the growing role of the private sector. As a result, Austin's volume remains a comprehensive reference for agroindustrial planning in the 1990s.
Introduction

*Agroindustrial Investment and Operations* is designed to complement Austin's work. It provides the investment analyst and enterprise manager with specific guidelines on the evaluation and operation of agroindustrial enterprises. The book is organized around three sets of questions that must be addressed in the analysis of investment options for agroindustrial enterprises in a market-oriented economy:

- What practical steps must be taken to identify, analyze, and select the components of an agroindustrial enterprise (marketing, processing, and raw material supply)?
- What information is needed to assess the financial viability of the proposed enterprise; what analytical techniques are most useful; what criteria should be used in financial analysis; how much capital will be required?
- What kind of management, administrative, and planning activities are involved in establishing a successful enterprise; what is the relationship between this investment and national development policy; and are advantages available in the form of incentives and protection if the investment furthers development objectives?

*Agroindustrial Investment and Operations* is primarily a guide for those designing or managing agroindustrial projects. However, it may also be used in academic or professional courses to teach the principles and methodology of agroindustrial project appraisal.

The book examines the basic characteristics of an agroindustrial enterprise. It explores issues and options that are for the most part independent of the type of process or product, then uses specific examples to illustrate their application. It presents analytical techniques used in making investment decisions and managing this type of enterprise. Successive chapters address questions such as how to establish and maintain a market, how to select appropriate processing options, what actions will ensure reliable supplies of raw materials, how to calculate financial requirements and meet them, and how to organize and manage an agroindustrial enterprise.

A Guide and Field Reference

The book has been indexed so that users will be able to locate readily references or discussions of particular topics. The material itself is presented in capsule form to facilitate reference to the discussion of specific aspects
of investment or operation. Each aspect of a feasibility study or management topic—from initial marketing design, to the organization of raw material supply—is self-contained and easily reviewed.

A Training Manual and Textbook

As a training manual, the book is aimed at two audiences. First, it will be of use to private investors and development professionals attending short technical courses on specific topics. Since each chapter of the book is a largely self-contained unit, someone interested primarily in marketing, for example, will be able to refer to Chapter 2, while those interested in financial analysis can focus on Chapter 5.

Second, university students and trainers will be able to use this book as a reference for longer, academically oriented courses in development or agricultural economics and integrated courses in project analysis or agroindustry. It is most appropriate for work at the postgraduate level, or perhaps the senior undergraduate level in the case of technical or financial programs.

A Working Definition of Agroindustry

Much time and intellectual effort have gone into the search for a definition of agroindustry that will distinguish it from agriculture and from industry. Since this book is concerned with the investment and operating decisions of an enterprise that functions between the producer of agro-based materials and the consumer or user, we will look for common operational issues in a definition, without worrying whether they may also be found elsewhere. Many of the issues and methodologies discussed in the following chapters are to be found in agriculture, in other industries, and in commerce. The important point is that if they have a role in successful agroindustrial enterprises, they have a place in this book. And so the comprehensive definition offered by Austin will also be the point of departure in this discussion:

An agroindustry is an enterprise that processes materials of plant or animal origin. Processing involves transformation and preservation through physical or chemical alteration, storage, packaging, and distribution.

Many of the examples and descriptions appearing throughout this text relate to one of the principal products of agroindustry—food—and to
the processing of it. Some of the most difficult tasks in agroindustry lie in food processing, not only because of the extreme perishability of many of the raw materials, but also the sophistication of the markets, the need for quality control, the high value added, the packaging requirements, and the strict regulations. Examples from this segment of agroindustry should therefore be comprehensive enough to meet the needs of most readers.

The complexity and quality control issues associated with investment design are often best illustrated by examples from international markets. Therefore export quality or export procedures are frequently referred to in this book. This choice of examples is not intended in any way to discourage investments for domestic markets. In fact, one of the more exciting developments in the past decade has been the growth and diversification of the domestic demand for processed agricultural products in developing countries.

A Methodology for Agroindustrial Investment Analysis

All agroindustrial activities consist of three basic subsystems: marketing, processing, and raw material supply. The "process" in question may be packing or storing, as well as activities more commonly thought of as processing, such as canning or ginning. Whatever the process, it produces an output that is subsequently distributed, and it requires certain raw materials. Each of these subsystems, and their interdependent relationships, are of concern in investment analysis.1

The chain of which the processing of raw materials is the central element can be viewed from two perspectives: It can be seen as the flow of information about market requirements that goes from the customer to the distributor and processor, and then to the producer; or as the flow of materials from the producer to the processor and distributor, and then the customer. Each approach has its purpose, and it is important for the analyst to understand which one is appropriate in any given situation.

The traditional approach to designing and analyzing a postharvest system has been to begin with the production of the raw commodity and

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to move forward through processing and distribution to the final markets. However, under most circumstances one is likely to encounter today, even in developing countries with limited natural resources, agricultural opportunities exceed market opportunities. The great risk in the production-oriented, or flow-of-materials, approach to project design, then, is that there will not be sufficient demand for the delivered products at the prices and quantities necessary to make the postharvest operations financially viable. Consequently, it is more appropriate to use the market-oriented approach in the design and feasibility study stages.

Market-Oriented Analysis

When assessing the commercial and financial prospects of an investment, the analyst should examine the proposal from the perspective of the final market. After all, the consumers or users—be they families or industrial enterprises—are the ones who will ultimately decide whether the enterprise is a success. The analyst's first step should be to prepare a comprehensive assessment of market conditions and requirements; the second step is to examine the processing design based principally on the dictates of the market. Finally, the analyst must consider the system whereby raw material will be obtained to satisfy the market and processing requirements. In this approach, the analyst is looking for answers to six basic questions:

- What products does the consumer buy, and in what volume and price ranges?
- What characteristics must the products have (e.g., composition, quality, packaging, availability)?
- What transport and distribution system will deliver the product in the form, cost range, and time frame required?
- What processing and packaging technology is required to meet these standards and what waste management technology will respond to environmental concerns? Can these be obtained and employed at a cost compatible with the projected end-market prices?
- What raw material supplies are needed to serve this market and the intermediary processing facility (e.g., their volume, variety, quality, seasonality, cost)?
• What level of production and technology is necessary, and what collection and handling system, to meet these raw material requirements? (What prices will producers require to maintain or expand production to meet the needs of the processor?)

Note that the decisions concerning the requirements for raw material production are derived from the dictates of the market. Markets are not a way of selling already planned production; rather, processing and production are a means of meeting market demand.

It must be emphasized that the above description of market-oriented analysis has been greatly simplified for the purposes of discussion. In practice, a prospective investor will—or should—have a clear understanding of the basic range of production and processing possibilities before beginning a detailed market analysis. It is this knowledge that keeps within feasible limits the search for underexploited consumer demand. In some cases, the possibilities may be quite broad. For example, a processor may be able to handle any humid tropical crop maturing in a three-month period when the facilities are idle. In other cases, the possibilities may be extremely limited, as they would be in a region that has a surplus of mangoes or guava. In that case the question becomes, what unsatisfied consumer demand might be identified for products that could be produced from one of these crops?

Materials-Flow Analysis

Once the strategic design decisions have been made, the next step is to prepare a detailed project design. This is the stage at which the materials-flow approach becomes essential. After the enterprise has been commissioned, this approach remains an all-important tool for managing production and controlling costs. The manager of a processing plant has little day-to-day interest in the vagaries of the final marketplace. It is enough to know what product is required, on what schedule. Once in possession of that knowledge, the manager must focus on the movement of materials through the production and marketing chain. Conversion and throughput efficiency become important measures of material flow in the constant struggle to make certain that unnecessary costs—such as wasted inputs, oversized inventories, and redundant staff—are kept to a minimum.
From the plant manager's point of view, the best approach to understanding the enterprise is the reverse of that required for initial investment analysis. Raw material suppliers must be told what to produce, and when. These raw materials must be collected and paid for at the right time and delivered to the plant in good condition. After the minimum period of storage, the materials must be processed, mixed with the correct ingredients, and packaged in the proper manner. They must then be stored again until they can be shipped to the local wholesale market, a seaport, airport, or some other destination. If the goods have been produced to specified standards of quality, price, and timeliness, the response of the final consumer is not the plant manager's immediate concern.

The market-oriented approach constitutes the basic framework for chapters 2, 3, and 4 of this book. Later chapters on financial analysis and management are presented in the context of material-flow methods.
2

Identifying, Developing, and Servicing Markets

Marketing is the process by which an organization identifies and satisfies a want of a customer. To succeed in this endeavor, a marketing strategy must make correct judgments about five interdependent elements of the marketplace:

- People. The organization must identify the customer and understands how the customer makes the purchase decision.
- Product. The product or service that the organization has chosen to produce must respond to the wants of the customer.
- Place. The geographic and organizational location of purchases must be correctly identified.
- Price. The price must be based not only on costs, but also on the purchasing power of the customer and the psychological reason for the purchase decision.
- Promotion. Information methods and persuasion must be appropriate both for the customer and the product.

These elements of marketing strategy are discussed later in the chapter, but first it is important to consider how a market orientation contributes to the success of agroindustrial ventures and how markets can be distinguished and evaluated.
Marketing and the Market-Oriented Enterprise

A market-oriented organization focuses on the specific wants of the target customer, and its entire marketing program is designed to satisfy that customer. In contrast, a sales-oriented organization is preoccupied with selling the products on hand. This second approach is less likely to experience commercial success because it cannot cope with the dynamic character of markets. One sure way to distinguish market- and sales-oriented organizations is to ask their senior management, "What specific customer wants does your product satisfy?" If the response is vague, the organization is not market-oriented.

Customers have fairly straightforward needs: They need food for sustenance, clothing for warmth, housing for shelter. But their "wants" are of a more subjective nature. What does this mean for marketing practice? Once their basic needs are satisfied, customers give higher priority to their "wants". Thus, they might prefer to buy a pre-prepared, gourmet, low-calorie, frozen entrée packaged in a heat-and-serve tray, rather than bulk staples, once they know it can satisfy the body's need for sustenance. Their decision is governed by a wide range of wants, such as convenience, or their desire to project a cosmopolitan image, demonstrate their economic standing, or satisfy a particular taste.

The great challenge for agribusiness firms is to identify the target customer. Is it the food shopper roaming the aisles of the supermarket? Is it the buyer for the supermarket chain? Or is it the food product distributor? In fact, it is all three. Commercial success depends on satisfying the wants of the final consumer as well as all the others who participate in the market system. The product must move smoothly from the point of production to the point of final consumption. This is the basic principle of the market-driven approach to agroindustrial business development.

The Market—A Business Definition

Business people use the term "market" to describe the groups of individuals or organizations that make up their pool of actual and potential customers. These groups fall into one or more of the following categories:

- Geographic. Customers may be identified by region, or by their urban, suburban, or rural location.
- Demographic (Socioeconomic). They may be older or younger; male or female; in a higher- or lower-income group; from a small or
large family; educated at the primary, secondary, or tertiary level; or from a special ethnic or cultural group.

- Psychographic. Customers may be, for example, diet or health conscious, may have active or passive life-styles, and may be leaders or followers.
- Behavioral. They may also be frequent or infrequent product users; may be conscious of price, or quality or convenience; and may have a positive or negative attitude toward a product.
- Sectoral. Customers may consist of households, hotels and restaurants, hospitals, schools, or further processors or manufacturers.

**Market Segments**

Every market can be divided into segments, each consisting of customers with similar wants and similar buying patterns with respect to a given product. The concept of the market segment is commercially important because marketing strategy can be developed around different segments; each segment can be satisfied with different forms, types, and sizes of the enterprise’s product, either by product differentiation or by using different distribution channels. In fact, many product lines have been developed by diversifying the output from a common group of raw materials in order to satisfy the wants of different market segments. Effective marketing consists of identifying market segments, selecting target segments, and positioning the product so that it has greatest appeal to customers in the target segment.

Consumer characteristics can also be used to identify types of market segment. For example, health-conscious, young urban professionals constitute a segment of the fruit and vegetable market. This segment may be reached through the fresh produce department of a supermarket chain. Moderate-income rural families represent another segment of the market. It may be best served with canned forms of fruit and vegetables distributed through national or regional wholesale companies.

Agribusiness managers frequently refer to their markets by product type, such as the market for fruit juice, or fresh fruit, fruit flavoring, dried fruit, jams and preserves, canned or frozen fruit segments, and so on. However, this approach focuses on production rather than the customer. It is important to recognize that dried fruit products, for instance, serve various market segments, from the “ingredients-for-baking” market to the snack food market, and customer wants differ in each of these mar-
kets. The market-oriented enterprise capitalizes on these unique wants by offering different "products" from the same basic raw materials.

A market segment must be identified by the common buying habits of its customers. Market research is essential for this purpose—but expensive. To be cost-effective, it must test hypotheses about characteristics that appear to be related to purchasing decisions.

**Coordination and Leadership in Production and Marketing**

Successful marketing begins by identifying the customer's primary wants. However, many different actions must be carried out in the production and marketing system before those wants can be satisfied. The product must reach the customer on time, it must meet specified standards, and production costs must remain within the budget. Managing this process means managing the materials-flow system, contractual system, regulatory system, and financial system.

In well-developed economies, systems and procedures tend to be standardized. Furthermore, some enterprises specialize in support services such as storage, transportation, freight forwarding, quality assurance, brokerage, and so forth. Production and distribution tasks can be delegated to these enterprises with some confidence, and the agribusiness manager need not control each aspect of the system personally on a day-to-day basis.

In other countries, these materials-flow systems may be shaky. They may have weak points that impose severe constraints on a marketing program. To succeed, firms must understand how these weaknesses affect their product so they can anticipate or resolve problems that could interrupt processing and distribution.

Many such interruptions occur in the supply of agricultural raw materials. Although agricultural problems are not conceptually within the purview of a postharvest firm, the market-oriented enterprise must be able to handle them if necessary and therefore may need to provide some assistance with agricultural inputs and husbandry. In the case of an exporting operation, in particular, the firm must be the supply-side leader; it must ensure that all activities are completed up to the point at which the product is delivered to the distributor or agent at the market site.

To maintain this kind of control over production and marketing, an export enterprise may have to perform activities that would fall to other
enterprises in countries with a fully developed production and marketing system. For example, a food manufacturer producing a variety of tropical fruit jams may have to produce a core supply of raw fruit materials, provide farm inputs (chemicals, credit, etc.) to outgrowers, supply transport from plant to wharf, and so on.

In many developing countries, businesses that export fresh produce cannot hope to achieve commercial success unless the exporter controls the product from the point of harvest to the point of loading onto the export carrier. In addition, they need to know something about inputs and husbandry practices on the production side, and often have to make extraordinary efforts—and bear significant costs—on the marketing side, to ensure that products reach their export customers. The successful produce marketer knows that a reliable supply is a prime ingredient of customer satisfaction; nothing hurts future sales more than shipments that arrive late, in poor condition, or not at all.

In general, the closer a business is to the point of the final sale in the production and marketing continuum, the better it is able to identify, anticipate, and satisfy customer wants. A commercial organization that is distant from its markets—geographically, economically, or culturally—will have to rely more on the intermediaries between itself and the final buyer. These intermediaries should become an integral part of an information system that delivers accurate, timely, and relevant information on present product performance and future market opportunities.

Market Development: Some Examples of Success and Failure

Market penetration and sustained profitable sales are the combined result of many correct decisions and successful actions. Most new marketing programs do not succeed. Of the estimated 8000 to 9000 new food products that are introduced into the U.S. market each year, only about 5 percent are strikingly new and try to appeal to unsatisfied—or unrecognized—consumer wants. The majority are extensions of existing product lines with attributes similar to those already available in other products. An estimated 80 percent of these new products fail to gain a sustained position in the marketplace. Such failure is often expensive; launching a new product nationally in the United States can cost US$40 million. Success, however, can be astounding: one new breakfast cereal, joining what might seem a plethora of cereal products on U.S. supermarket shelves,
had first-year sales of US$75 million in 1987-88, and one diet drink achieved sales of US$1,000 million in its first year.

The following examples of success and failure illustrate some of the critical factors to consider in market development.

The top of the market for fine green beans in the United Kingdom has been captured largely by Kenyan suppliers with “haricots fines” or “needle beans” that are merchandised through upscale restaurants or retailers of “quality” fresh produce. “Kenya Beans” has come to signify a top-quality standard that other suppliers strive for. Kenyan produce is grown not only on larger farms, but also on small out grower farms that supply firms that assemble, grade, and pack the beans for sale in the United Kingdom and other European markets. The consistent quality and year-round supply of Kenyan fine green beans have earned them an attractive position in a profitable market.

Jamaica has established its Blue Mountain coffee as a premium product that merits a premium price, particularly in the Japanese market. This success has been achieved by capitalizing on the inherent characteristics of coffee and careful product positioning to satisfy higher-income consumer demands for coffee that is perceived as being exclusive and the product of choice for the gourmet coffee drinker.

Many attempts to export dried fruit from developing countries to Europe and North America did not succeed because exporters failed to appreciate that the export customer—unlike their domestic consumers who value sweetness—identifies dried fruits and fruit juices with sugar-free “health foods.”

In the past, bananas sold on the U.K. market were of a strictly regulated length. Smaller fruit, in particular, was rejected at the point of supply and sold on lower-value markets or dumped. Bananas are sold on the basis of weight, and as the real prices for bananas rose in this protected market, consumers sought shorter bananas to keep the proportion of the food budget spent on bananas at a reasonable level. A market-oriented retailer identified this unsatisfied consumer want and sent the signal back to growers and shippers. Today, smaller bananas can command a premium price on the U.K. market.

The sales of many sauce and jam products exported from developing countries have failed to expand beyond the confines of small loyal ethnic markets either because product quality has been observably poor (e.g., it contains air bubbles, or the ingredients have settled out) or the packaging and labeling did not meet the requirements of mainline customers. Such
basic factors as inadequately translated product information, poor artwork on the label, and inappropriate or unappealing brand names had a negative effect on sales.

Understanding the Consumer: Factors That Influence the Purchase Choice of Food Products

Markets for food products in developed countries are prime targets for developing country agribusinesses. These markets are often far from the would-be suppliers, not simply in terms of distance, but also in terms of technology, product sophistication, economic development, and culture. Suppliers therefore find it difficult to form a clear picture of consumer wants and specific product requirements. Rapid market changes add to the problem.

At least 10 factors explain why consumers in developed and developing countries alike buy what they buy, and why the food market environment has been changing so rapidly in recent years. These factors represent by and large universal trends that are simply more pronounced in some markets than in others.

Absolute and Relative Prices

Market analysts have formulated two key concepts concerning choice in the purchase of a product: the price elasticity of demand, which measures consumers' purchasing response to a change in the price of a product; and the cross-elasticity of demand, which measures consumers' purchasing response to a product after changes have occurred in the prices of competitive or complementary products. These concepts of elasticity are at the heart of the questions the market analyst seeks to answer:

How important is product price to the consumer in deciding whether to buy the product? If the product is a staple food (bread, maize meal, rice, sugar, etc.), purchasers will tend to be unresponsive to small price changes. Items that add variety to the diet or enhance nutrition beyond subsistence levels, such as meat and horticultural products, represent somewhat more discretionary purchases and are more subject to price consideration. In general, a price increase for one of these discretionary food products will result in a reduction in sales (and vice versa). The market analyst must have a clear understanding of the factors that
could change market price and of the impact that price changes are likely to have on the sales volume and profitability of the proposed operation.

**How is the product priced in relation to competitors and substitutes?** One brand of a product must be within the competitive price range of other similar products in the same market segment. The product can command a premium price over its competitors, but this price must reflect additional qualities perceived and wanted by the consumer.

**Are sales closely linked to sales of another product or to a means of cooking or food preparation that may prove to have only ephemeral popularity?** Some sauce ingredients are used for a specific type of meal. For example, a large share of hot pepper consumption in North America is related to the popularity of Mexican cuisine. Mint sauce is consumed primarily with lamb. If, for any reason—such as a health scare about “hot” foods or a long-term decline in lamb consumption—the type of meal goes out of fashion, the demand for the accompanying product can vanish. Conversely, a boom in the demand for the main product can accelerate sales for the accompaniment. Health-concerned consumers switching from red meat to fish would sharply increase the demand for fish sauces, fresh lemons, and the like. The lesson for the market analyst is that product price is not the only factor to influence market prospects of an organization’s product.

*Individual and Household Income*

The impact that changing levels of income have on food consumption and the food-purchasing decision is termed the income elasticity of demand. For example, as income increases, the consumption of staple items decreases, because consumers switch to foodstuffs perceived to be of higher quality. Meat consumption increases sharply with increasing income, although at relatively high income levels, the consumption curve flattens out for meat as well and may even fall. Wealthier households spend proportionately less on food than do poorer households. This illustrates Engel’s law: while rich people can afford to buy more than poor people, there is a saturation level for the purchase of food.

When estimating demand for many food products, household income is the key variable, rather than individual income. A household of two income-earning individuals and no children has considerable purchasing
power. Such households have drawn the attention of high-margin, up-market food product manufacturers as this category of consumers has sought to satisfy its wants for excitement, prestige, convenience, and the endorsement of peer group members by purchasing unusual and exotic food products. Under such conditions, high prices sometimes actually boost sales.

Household Size

Households in most developed countries are growing in number and shrinking in size, and this trend has significant implications for the manufacturers of food products. More than half the households in the United Kingdom consist of only one or two persons. Not surprisingly, these households purchase smaller units of food products than larger households. They tend to eat more of their meals outside the home. In the United States, one-person households spend half of their food budget on meals in cafes and restaurants, whereas families with five members or more spend one-quarter of their food budget away from home. The implication for the company marketing food products in the United States is that, while the absolute amount of income spent on food is not declining, it is being spent in different market segments.

Age of the Population

The average age of the population is increasing in most developed countries, and older consumers have distinct food-purchasing preferences: they exhibit strong brand loyalty, accept less preparation in their food products, seek small packs and portions, are less willing to indulge in the food fads and fancies of the younger generation, and have nutritional concerns and requirements that translate into a demand for products such as vitamin- or calcium-enriched beverages.

Increasing Number of Women Working outside the Home

Forty percent or more of the women in most European countries work outside the home, and the figure is much higher in the United States. This phenomenon has contributed to the explosion of convenience food products and to the extended hours of food retailing establishments, many of which are now open seven days a week and even 24 hours a day. Technol-
ogy has responded to this trend with devices such as the microwave oven, which has revolutionized cooking methods and greatly reduced the time required to prepare foods—and has created markets for new, or newly packaged, products.

Education Level of Consumers

The average school-leaving age in most developed countries has increased substantially over the past 30 years. Similarly, the proportion of the population that receive post-secondary education is rising. Consumers in this group are more concerned about the impact of diet on health and nutrition. Food products that have "less sugar," "less salt," "no cholesterol," "more calcium," and "more fiber" have wide appeal to these consumers. Increasing consumer interest in fresh, rather than processed, fruits has opened up a wide range of markets for exotic and off-season fresh produce. More than 80 million consumers in the U.S. market are frequent purchasers of low-calorie "diet" foods and beverages, an increase of more than 100 percent since the early 1980s.

Increasing Travel by Consumers

People in the developed as well as developing economies are traveling more often and more widely. As they sample a range of foodstuffs, they bring new preferences home and seek exotic products in the supermarket. This trend is apparent in the increasing shelf space given to "international" foods in the supermarkets of North America, Europe, and Japan; their wider availability in the markets of Asia and Africa; and in the proliferation of different restaurant types in many urban centers. However, the label "international" or "foreign" does not necessarily refer to the point of processing or manufacture, but to the type of food. In 1987 close to 3,000 new food products introduced in the United States had a non-U.S. or ethnic name on the label. The vast majority were launched by domestic companies and made in the United States.

Breakdown in Traditional Meal-Eating Habits

One seemingly inexorable side effect of the development process is the gradual breakdown in traditional meal-eating habits. With more income and leisure time, families spend their food budget in different ways. In
Europe, for example, the Sunday roast meat lunch was, for many, the centerpiece of the week—the one opportunity when all family members would sit down together for a meal. In many cases the meat item represented as much as half the week's expenditure on all meats. Of course, the roast was "stretched"—served as a hot roast on Sunday, cold meat on Monday, and minced on Tuesday.

Nowadays, leisure activities take precedence over meal preparation. Once again, no less is spent on food, but it is spent differently: eating at restaurants, and buying prepared food items or snacks.

**Increasing Mobility of Consumers**

Increasing migration both between and within countries is transforming national diets. The widespread availability of Latin American fresh and processed food products in the supermarkets and restaurants of the southern United States is a particularly striking example. In 1988 there were 19.3 million consumers of Hispanic background in the United States, with an aggregate household income of about US$130,000 million. The U.S. Census Bureau projects that by the year 2000 there will be 27 million Hispanics in the United States, and they will account for 10 percent of the population. In 1987 U.S. companies spent US$490 million on advertising that was targeted specifically at the Hispanic community—double that recorded for 1983. This large consumer group demands food products that recall the ambience of Latin America. However, other North American consumers are also drawn to try Hispanic food products as they become more widely available on retail shelves and in restaurants.

**Change Generating Change**

A great many new food products appeared in North American and other developed country markets during the 1980s. Consumers show a willingness and have the disposable income to try new products. Technological advances in the food industry and in allied sectors such as long-life, "shelf-stable" product packaging and microwave cooking have increased the food manufacturers' capacity to meet the varied and exacting requirements of the diverse consumer market. In effect, change generates more change, providing an increased range of market opportunities, but with increasing levels of competition and business risk for agribusiness firms.
Identifying Market Opportunities

The increasing diversity of products in the marketplace is good news for the consumer and provides the food product seller with greater opportunities to establish a market niche for "custom-designed" products. But to exploit this expanded range of market opportunities the seller must thoroughly understand the complex and dynamic market environment. That understanding can only be acquired through constant contact with the market; consequently the suppliers who are separated from their customers by a large geographic or cultural distance are at a disadvantage.

Review of Past Marketing Performance

The first step an enterprise should take in assessing the feasibility of a proposed marketing program is to review its past marketing performance. What have been its marketing strengths and weaknesses and why?

- Did the seller have a thorough understanding of the specific wants of a target group of customers, and were product characteristics tailored to satisfy these wants?
- Was an analysis made of the competitive environment, including market structure (to determine who the competition is and what their relative strengths and weaknesses are); the basis for competition in the target market (price, quality, access to key raw materials); and constraints to market entry (tariff or non-tariff barriers, investment requirements)?
- What distribution systems were targeted in the past? Processors or manufacturers? Supermarkets, specialty and ethnic stores, the hotel and restaurant trade? In which countries or regions?
- What were the marketing responsibilities of the organization itself—was there a joint-venture partnership representing mutual interests in the target market; was there an export agent, broker, or distributor?
- Was success predicated on access to scarce raw materials, price competitiveness reflecting low-cost production structure, or another factor?
- What was the sales and profit record for past programs? Were sales and profits sustained?
Past performance is a useful indicator of expected performance in the future. However, this only holds if business activities proposed for the future bear some relationship to the type of activity undertaken in the past. It may be a substantial leap to move from servicing the wants of a local market to that of an export market. The domestic market may also limit competitive pressure and impose barriers to entry for imported products, whereas the export market may have its own mature agribusiness sector and be a target for the world’s food-exporting nations.

At a minimum, the retrospective analysis of marketing performance should provide the management of both the marketing organization and the financial institution considering a loan or equity investment with a basis for measuring the organization’s capability to undertake the proposed marketing endeavor. A complete lack of export experience does not, and should not, preclude an organization from export marketing, but as a general rule, firms should not attempt to develop export markets until they have successfully implemented domestic marketing programs.

The Marketing Hypothesis

The typical form of a marketing hypothesis is as follows:

If we make a new product, change an old product, or target a new market, then we can satisfy a set of consumer wants and make a profit for our organization.

It is critical in the early stages of evaluating the commercial feasibility of a venture to identify and validate a market hypothesis. However, many enterprises neglect to formulate a hypothesis, or, if they do, it may be far too vague to use as a measure of feasibility: “The product has sold well at home, so we thought we might give it a try on the export market,” or “We’re desperately short of foreign currency for spare parts, so we’re going to export,” or “Similar products sell for US$2.00 at retail in the United States, so we’re going to target this high-priced market.” These statements do not provide a firm basis for investing in an export venture; the first two examples represent the antithesis of market orientation and the third is naive in the extreme.

A clearly enunciated market hypothesis—preferably in writing—forces the firm’s planners to identify the factors that will contribute to the success of the venture. After satisfying themselves that the hypothesis is valid, marketing management should establish objectives that set mea-
surable targets in relation to such factors as profitability, sales growth, improved market share, diversification, innovation, and the potential for generating foreign exchange. Together, the marketing hypothesis and its associated marketing objectives provide an analyst with a starting point for evaluating the related investment project.

**Primary and Secondary Sources of Market Information**

A marketing hypothesis cannot be tested or the feasibility of marketing objectives evaluated without information on the proposed market. At a minimum, the prospective supplier will require information on the following aspects of the market:

- **Consumers.** Who they are, why they buy, where and how often they buy, how much they pay. Do prices vary, and if so, how much and why? Consumers can be householders buying at retail stores or a food manufacturer seeking processed inputs for further manufacturing or repackaging.

  - **Market structure.** Who are the competitors? Do they have distinct advantages? Are there substitute products? What are the major market channels? What is the basis for competition? Are there significant barriers to market entry?

  - **Potential distributors or marketing partners.** As an extension of market structure information, what further processors/distributors could provide a link between the point of manufacture and the point of the final sale?

There are two basic categories of market information: **primary** and **secondary.** Primary information is based on data that the market analyst generates or collects. Secondary information is drawn from the data and previous analyses undertaken by a third party; the effort involved in reviewing secondary information is sometimes called “desk research.”

**Secondary Sources of Market Information.** Information about markets is plentiful and readily available, but it is invariably too general to meet the needs of a particular marketing proposal, and it is often out of date. Nevertheless, reviewing secondary material is usually a low-cost means of screening a wide range of possibilities to arrive at a few manageable and realistic market opportunities. Secondary information can be obtained from public and private sector sources. Marketing information
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sources financed by the public sector are generally of three types: market reports, market studies, and trade statistics. Private sector information can usually be drawn from various trade publications.

Market reports. Market reports present a regular review of activity in the primary wholesale markets. They provide statistics on prices and sales volumes for a wide range of agricultural products, largely fresh products. For example, the government departments representing agriculture and food in the United States (U.S. Department of Agriculture, USDA), Canada (Agriculture Canada), and the United Kingdom (MAFF) regularly report information on the fresh produce market.

Organizations such as COLEAP (based at the large produce wholesale market at Rengis, close to Paris) and the International Trade Center (U.N. Geneva and New York) provide regular analyses of fresh tropical produce and off-season conditions on fruit and vegetable markets in the principal wholesale centers across Europe and North America. Perhaps more useful for processed food exporters, the Foreign Agriculture Service of USDA publishes Situation Reports and Outlook Reports on a wide range of food commodities, identifying global production, price, trade, and market trends (see the case study in the appendix to this chapter). Similar studies are produced by the Food and Agriculture Organization of the United Nations.

Market studies. Market studies on fresh and processed products that appear to show potential for developing country exporters are sometimes available from export promotion agencies in developing countries. These studies are often financed by bilateral and multilateral aid agencies; the U.S. Agency for International Development (USAID), and the International Trade Center (ITC) are the most prolific agencies in this regard. USAID focuses on the U.S. market, while ITC has a more global market perspective. Other public sector agencies financing or publishing food product market studies include the Commonwealth Secretariat and the Overseas Natural Resources Development Institute (London), UNIDO (Vienna), Center for the Promotion of Imports from Developing Countries (Rotterdam), and the Canadian International Development Agency (Ottawa).

The agribusiness market analyst searching for marketing studies should contact personnel in ministries of trade, agriculture, or finance or the export market development agency in the country in which the enterprise is located; the local offices of bilateral aid agencies (particularly officers in the areas of private sector development, agricultural, and infor-
mation services); the local offices of regional and international financial institutions and agricultural service organizations such as the World Bank, African Development Bank, Asian Development Bank, Inter-American Development Bank, IICA, and CGIAR research centers.

**Trade statistics.** Trade statistics can provide invaluable clues to export market opportunities through information on product flow between exporting and importing countries. Generally, the import statistics of developed countries are more up to date, accurate, and detailed than those on exports from developing countries. Trade statistics on product volumes tend to be more reliable than those on product values; some traders undervalue shipments to minimize export taxes or import duties or to confound the authorities in charge of foreign exchange.

Almost all countries use the Standard Industrial Trade Classification (SITC) to categorize statistics on imports and exports. For specific food products, even the five-digit classification may not be detailed enough to yield useful market information beyond general trends. Unless the product being researched is traded in very large volumes, the analyst will invariably find that it falls under such diverse headings as "other frozen vegetables" or, worse yet, "food products not elsewhere specified."

**Trade publications.** The most widely available information on markets in the private sector can be found in trade publications directed toward such groups as producers, food manufacturers, food distributors, retailers or restaurateurs, and the hotel trade. Although trade publications can be illuminating, they should be treated with caution. Their perception of "the long term" does not correspond with that of most project analysts. The trade press focuses on the immediate past, the present, and the immediate future. For example, a headline that reads "Sales Prospects Excellent for Spaghetti Sauces" has only limited relevance for a sauce manufacturer considering a new product that will be coming on stream in 12 to 18 months.

The number of food industry trade newspapers and magazines covering the European and North American markets is very large. Regular publications are available on every aspect of the industry—food engineering, packaging, new products being introduced, manufacturing, and retailing—and even on narrow subsectors of the market.

Which publication the analyst should review will depend on the area of interest, local availability, and the consensus of others in the trade. The most widely read publication for information on the fresh produce market in North America is the weekly newspaper *The Packer*; the corre-
sponding publication in the United Kingdom is the *Fruit Trades Journal,*
the monthly *Progressive Grocer* is the most widely recognized trade paper
covering grocery product retailing in the United States. Trade magazines
often publish annual reviews and details on changes in product sales
trends, engineering advances, and the like. They can be a valuable source
of export marketing information for any organization with a serious
interest in a product or production process and its relationship to an
export market.

*Trade directories.* Trade directories can provide useful market information
for exporters selling into the processing and manufacturing sector of
an export market. Such directories should be readily available through
the commercial sections of embassies and consulates of the countries in
which the target markets are located. Trade directories for the United
States list, by product group, the names and addresses of firms that manu-
ufacture and distribute each product. A potential exporter of a tropical
fruit pulp, for example, can identify firms in the fruit flavoring, ice cream,
fruit juice, conserves, and other processed fruit sectors and identify
potential buyers to contact.

**Primary market information.** Secondary market information is very
useful in focusing the marketing investigation, and later, for monitoring
market developments. But there is no substitute for firsthand research
into market conditions and prospects. Ideally, this primary research
should be done in two stages. First, the senior marketing management of
the enterprise should visit the prospective market—whether or not the
organization has an export market-based partner. Second, the issues iden-
tified on the basis of the secondary information and the visit by senior
management need to be analyzed quantitatively in a focused research
program.

*Market visit by senior management.* The export program is unlikely to
get off the ground, particularly in medium and small firms, if the senior
company executives do not investigate the market opportunity at first
hand. They need to obtain the views of three groups in particular con-
cerning the opportunity:

- Final consumers of the product, be they householders, chefs or
  food service managers, or manufacturers. A walk around a super-
  market observing the range of products available, type of packag-
  ing, their country and company of origin, the shopping behavior of
consumers, and the views of supermarket staff on product prospects is an excellent means of gaining insight into the retail market. Be sure to note how the particular product is presented, and the implications for packaging.

- Personnel of organizations that merchandise products of interest to final consumers (for example, wholesalers, brokers, distributors, and processors). Trade shows and trade conventions represent good occasions to meet large numbers of prospective interviewees in one place at one time. Information on which, when, and where trade shows are scheduled can be solicited from the trade development officers of embassies representing both the exporting and prospective importing countries.

- Government trade regulation personnel responsible for clearing product entry into the importing country. For example, some processed food products entering the United States require the approval of the Food and Drug Administration; most must be approved by the Department of Agriculture. It is often useful to learn at first hand the requirements to be met, import documentation procedures, and so on.

Interviewing trade participants can be a bewildering experience. Here are some practical points to keep in mind:

- Clarify the exact price basis being used in any discussion (e.g., c.i.f., c.& f., ex-warehouse).
- Establish the time frame of the discussion. To a trader, the long term may be equivalent to the analyst's short to medium term.
- Carry samples if you can, but at least be prepared for factual discussion. Trade members have great difficulty talking in hypothetical terms; they want to view the potential export product during the interview.
- Watch for excessive optimism or pessimism. Food trade members seldom share market information, and they have been known to mislead an interviewer, particularly if they believe that to do so is in their own interest. Some food trade member may be negative about export market prospects for almost any products from developing countries; others may be unrealistically optimistic, particularly if they have no financial stake in a proposed venture.
Quantitative market research. A personal market visit by the management of the prospective exporting firm provides firsthand information on problems and prospects that need to be addressed, and it demonstrates corporate commitment to prospective customers. But this is qualitative, not quantitative information. The enterprise can expand and refine this base of marketing knowledge in three ways:

Employ a market research company. This can be a relatively expensive service, and may be financially difficult to do, particularly for companies short of foreign exchange. However, properly focused, such research can sharply reduce the risks associated with market entry. In some cases, financial assistance to cover market research costs may be available from export development agencies or export development programs of multilateral and bilateral aid agencies.

Undertake detailed market research. Here again, cost may be a factor, but external financial support may be available. Before choosing this option, it is important to ensure that the company's research staff have the appropriate experience and analytical skills to conduct the required work. Otherwise, the results may be of little use, even though the direct cost may be less than that involved in engaging the services of a market research company.

Associate with a marketing partner based in the target country. A good marketing affiliate can generate needed marketing information from its own knowledge base in order to facilitate research, and initial costs can be minimized in return for future participation in marketing.

All three options have their merits, and the potential exporter should employ at least one of them to develop his knowledge of the market. But this type of research activity is not an academic pursuit. The question should be asked continually, "How are we going to use the information that this research will produce?" The research results must help managers make better decisions; if they don't, the wrong research questions are being asked, management is misinterpreting the information, or both.

The Marketing Strategy

As mentioned at the beginning of the chapter, the essential factors to consider in designing a market strategy are the people who constitute the target market, the product chosen, the place in the marketing system where the product is to be sold, the price, and the promotion plan for the product.
An agrobusiness must take the following into account when selecting a geographic area as an export marketing target:

- Prior knowledge of and previous experience in the geographic market. Does the organization understand the requirements of the market area (cultural, product use, product ingredients, packaging, etc.)?
- Traditional market linkages. Is there, as a result of such factors as past immigration patterns or past political connections, a consumer base that is predisposed to purchase the type of product that the export organization can produce, or does the exporter enjoy preferential access as a result of past relationships?
- Transportation linkages. Is there regular and dependable transport of the type suited to the product in question between the point of supply and the market?
- Absence of significant tariff and nontariff barriers. Which geographic market areas offer preferential access for the exporter’s products (e.g., tariff-free access to European Community countries for Lome Convention countries, Caribbean Basin Initiative advantages for access to the United States, CaribCan initiatives for preferred access to Canada)? Are there significant barriers to entry in the form of sanitary and consumer safety requirements? Does the potential importing country have import quotas on product entry?
- Direct competition from other exporters. Do exporters from other countries have insurmountable advantages because of their proximity to the market, preferred tariff arrangements, or other bilateral agreements?
- Convertibility of foreign exchange. Does the importing country have a currency that is easily convertible? If not, what regulations, limits, or procedures are imposed on remittances, and what is the effect on net sales proceeds? If other forms of payment, such as countertrade, must be used, what is the effective price received for the exports?
- Marketing system contacts. Does the exporting organization have a marketing partner or agent in the importing country to handle the market-side distribution and promotion of the product?
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The enthusiasm about exporting usually present at the planning stage should not obscure the stark reality of the difficulties involved in penetrating highly competitive, distant markets. The analyst should examine the rationale and, certainly, the timing of a proposed export program. Has the enterprise exploited the potential of the domestic market or of adjacent regional markets?

Domestic markets in developing countries tend to be less competitive than large extra-regional markets, and to offer higher margins. Furthermore, a domestic marketing program can be used to test the reliability of supply and consistency of quality of the future export product. The local market may not penalize mistakes as heavily as the export market. In short, a domestic marketing program provides the enterprise with an opportunity to learn from and to correct mistakes that could prove fatal if made in the export market.

The domestic base can also be used to test-market a potential export product. One jam and preserves manufacturer learned a great deal about the breakfast-time conservatism of the North American consumer by testing a range of tropical jams (soursop, mango, guava) on tourists in a Caribbean Island hotel. The marmalade and strawberry jam portions were selected consistently in preference to the more exotic jams. The manufacturer concluded that the tropical jams product would be swamped on the North American supermarket shelves by more traditional jam products and that gourmet stores and specialty mail-order houses were more appropriate markets, at least for further market testing.

Identifying and selecting a market niche. Gone are the days—if, indeed, they ever existed—when an agribusiness could pack, ship, and sell a part of its processing plant output to some distant export market with little attention to the needs of the foreign consumer and a badly translated product label declaring the contents of the can! The commercially successful approach now is target marketing. The agribusiness firm searches through a multitude of market segments, selects one or more, and then develops products and marketing mixes tailored to satisfy the wants of each segment. Marketing mix is the term used to cover such marketing elements as physical product (ingredients, quality, brand name, packaging), product price (including credit terms, discounts, allowances), product promotion (advertising, in-store promotion), and product distribution (marketing channels, storage, etc.). The marketing mix for one target market may differ substantially from another, although
the basic product (as defined by ingredients, quantity, and quality) may be identical or, at least, very similar.

The development of the market for hot sauces in the United States in recent years illustrates the notion of market mix. The total sales of hot pepper sauce have grown rapidly, since the addition of target-market niches. Four broad consumer categories were targeted: (1) ethnic consumers (largely Hispanic and Caribbean) who are relatively heavy users and are seeking traditionally packaged hot pepper sauce products that remind them of the product's origin; (2) consumers in the southern United States who have traditionally purchased a relatively milder hot sauce from a U.S. source; (3) new consumers drawn to the spicy product because of an awakening interest in exotic, foreign, "hot" foods, but who wish to be reassured about product quality; (4) the food service trade, which has bulk purchase requirements for products offering a range of spiciness.

The basic hot pepper sauce product demanded by each of these consuming categories differs only marginally, but pricing, packaging, distribution, and place of final sale are manifestly different. Recognizing different customer wants in relation to the same basic product and selecting a particular group of customers is target marketing.

Target marketing consists of three steps: market segmentation, market selection, and product positioning.

**Step 1: Market segmentation.** To achieve effective segmentation, the agribusiness must (1) measure the size and buying power of the market segment and determine if it is big enough to make the marketing effort worthwhile; (2) reach the market segment through advertising and point-of-sale promotion; and (3) service the wants of the market segment, not only in terms of customer preferences, but also in terms of the resources needed to supply the minimum requirements for market entry.

Once these conditions have been met, the agribusiness can decide whether to segment the market on a geographic, demographic or socioeconomic, psychographic, or behavioral basis. Potential customer profiles should then be developed to identify the salient characteristics of each segment, particularly as these characteristics relate to product purchase behavior.

**Step 2: Market selection.** Market segments to be targeted are identified by (1) reviewing marketing objectives to determine which ones are to be pursued in this marketing program and their relative importance (e.g., is profit maximization the driving force behind the export program, or is it...
A Thumbnail Market Feasibility Test

Identifying market opportunities can be a costly and time-consuming exercise. To ensure that the export enterprise is realistic and is tracking potentially profitable opportunities, it should have a rapid method of identifying which of the many apparent opportunities are worthy of in-depth analysis. Fundamentally, the organization needs an early indication of whether the expected ex-plant price for a potential export product is higher than the expected ex-plant cost. The following information is required to make this judgment:

- Target market size and attainable market share
- C.i.f. price and minimum order
- Cost and availability of freight and insurance services
- Cost and adequacy of marketing infrastructure (e.g., refrigerated storage space, road conditions, inland transportation)
- Specific buyer(s) with credible level of interest in marketing the product(s)
- Preliminary indications of risk associated with these factors.

A Note of Caution: One of the most common mistakes in evaluating export markets is to underestimate the costs of moving the product from the port of entry to the point of final sale. For both fresh produce and processed specialty food products, the price at the retail store level can be more than twice the price of the landed product. For example, a canned tropical food product might attract a retail margin of 40 percent of the retail price, plus a further 15 percent to cover special allowances and the cost of introducing a new product. In addition, an importer or distributor of specialty products will take a markup of 15 to 25 percent on the landed cost, depending on the level of service provided. In this case, the landed price would be about 40 percent of the retail price.

market diversification?); and (2) using quantitative measures such as net income per unit of sales, or share of total sales, to determine which target markets appear most capable of satisfying the marketing objectives.

**Step 3: Market positioning.** For each target market selected, the agribusiness must establish the "position" that the product should have in the mind of the potential customer. To do so, it must answer the following questions concerning the potential consumer:
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- Who is the user (e.g., young couples, children)?
- What are the most important features of the product (e.g., "all natural ingredients," "sugar-free," "high quality")?
- What specific wants does the product satisfy (e.g., satisfies the want to have a healthy diet, gives nutritious food to children, impresses friends)?
- When and how is the product used (e.g., as a main meal or snack item, for children's lunch boxes)?
- How does the product differ from its competitors (e.g., more taste, longer-lasting, spicier)?

The underlying purpose of the market positioning exercise is to determine how best to differentiate the enterprise's product from the mass of other, often very similar, products in the marketplace. By focusing on the specific wants of target market populations, the supplier can foster a distinct and preferred view of a particular product that will predispose the target customer to buy it in preference to competing products.

The Product: Responding to the Customer

The product to be marketed ultimately depends on the needs and wants of the target market. Of course, it is also governed by processing and raw material supply considerations (see chapters 3 and 4), but the task of product selection should begin by examining customer requirements and preferences. Four aspects of product definition are of particular concern: quality, packaging, degree of processing, and product mix.

PRODUCT QUALITY. Quality must be defined in terms of the demands of the market to be served: What characteristics are buyers willing to pay for? What characteristics are required by third parties, such as government health agencies or trade associations, that look after the interests of buyers? In other words, what quality features will promote the sale of the product and what features will facilitate access to the market? The principal factors affecting quality are those that have to do with market acceptance, health and safety, stability or shelf life, consistency, and cost-effectiveness.

Market acceptance. In the case of a food product, consumer appeal is first elicited by the product's appearance (color, shape, and size) and aroma. Taste, texture, blending qualities, and nutritional value may be
added to the list before the consumer decides to buy a product the second time. The relative importance of these dimensions of consumer appeal will vary from product to product, and from segment to segment of the market. Technical specifications have been developed for each of these dimensions in the case of most products. The analyst should use these specifications to describe the chosen product to those designing the processing plant that is to supply the proposed market.

If the products are to become the inputs to another industrial process, market acceptance will depend on two sets of factors: (1) those of interest to the final user, and (2) those that will affect the quality and efficiency of the intermediate process. In the case of cotton lint, the range of final products that can be produced from the lint will depend on the length, strength, and uniformity of the staple. However, the spinners and weavers who use the lint will also be concerned with its color, condition of the fibers, and the amount of foreign matter they contain, because these factors will affect their production costs for washing, carding, and spinning.

Health and safety. In most cases, information on health and safety standards can be obtained from the organization responsible for enforcing them (e.g., the Food and Drug Administration in the United States or its equivalent in other target markets, the Department of Agriculture, customs authorities, trade associations, and independent inspection services). The standards for food products are normally concerned with the level of purity, the use of additives, the thoroughness of the cooking or other preservation process used, and agrochemical residues.

The standards of purity for processed foods are normally expressed in terms of the allowable limits of the most common foreign materials. More and more regulations are being introduced to address concern over the additives in processed foods and the residues of agrochemicals on horticultural crops and stored commodities, particularly in OECD markets. Firms interested in supplying food products to these markets must become familiar with these regulations and must comply with them if they do not want their products to be rejected at the port of entry. Additives such as those that enhance color, flavor, or stability must usually be selected from a list approved by the food safety agency governing the particular market. For processed foods, the greatest concern is that bacterial and other microorganic decay may produce dangerous by-products if the process is not adequately performed. Standards are expressed in terms of allowable limits for the population of these microorganisms after a specified period of time.
Health and safety standards may apply to packaging as well. In some cases these will relate to the nature of the product. For example, the can specification for highly acidic fruits such as pineapple differ from those required for peaches or green beans. In other cases, package specifications pertain to the quality of seams and joints, or similar factors that are independent of the contents. The types of specifications used for unprocessed crops in the United States are uniform grade nomenclature, standards for grades, color requirements, tolerances for grade defects, packing requirements, special definitions (e.g., texture, color), damage (degrees of), styles, standard sizing, standard weights, standard pack, maturity requirements, standards for export, count per unit weight, special standards for crops for processing, solidity classification (lettuce), juice content (citrus), samples for grade and size determination, and sample plans. Note that not all of these items may be specified for any single commodity. According to the U.S. Code of Federal Regulations, the specifications for processed fruits and vegetables include product description, fill of container, quality factors, color, defects, flavor, texture, sample plans, sample size, style (diced, creamed, etc.), lot inspection, lot compliance criteria, liquid media requirements (brix or soluble solids drained weight size), definition of terms, tolerances, score sheets, methods of analysis (identity standards, grade definition), moisture content (sulphur dioxide content), and proportion of ingredients.

Health and safety standards are the most commonly applied nontariff barriers to trade. While these standards may be misused to this end, most problems arise because the supplier does not know or respect the requirements. Hence a careful investigation is particularly important at the pre-investment stage.

Consistency. In most markets for agro-based products, quality must be consistent in order to maintain consumer acceptance and market access. Brokers and distributors do not want to have to inspect every shipment; they cannot inspect every unit. Trade is usually conducted on the basis of written specifications, and sampling is done only to confirm that these specifications are maintained. Therefore the specifications for the products of the proposed enterprise must also include tolerances, that is, ranges above and below the median values of the standard. In some cases, these will be written into the regulations governing the particular standard; in others, there will be trade norms to guide the designer. To sustain its market performance, the enterprise must know and respect these ranges.
Shelf life. Any agro-based product will deteriorate over time, whether it is pasteurized milk, which may be salable for only a few days after processing, or cotton yarn, which may last many years. The distribution systems that have evolved for different types of product are related to the normal shelf life and the storage conditions required for each type. If an enterprise hopes to avoid losses, added costs, and buyer rejection, it must conform to the standards of the distribution channel.

In addition, the designer should examine the merit of supplying different target markets with product variations based on different shelf life. For example, the processes that extend shelf life usually alter the characteristics of the material being processed, and certain segments of a market may prefer different combinations of these characteristics. Some buyers are willing to pay a premium for a product that retains most of its original traits. Distribution costs will usually be higher in this case because of the capital intensity of the distribution chain (e.g., cold storage), the premium on time, and the greater cull losses because of the higher raw material standards.

Some products that are more costly to process can be distributed at lower cost to the buyer by virtue of their improved shelf life. Ultra-high-temperature milk (UHT) is a good example. It costs more to process and package UHT milk than pasteurized milk, but, properly packaged, it need not be distributed through a cold chain, and its quality remains safe for several months. This helps to reduce distribution costs and makes fluid milk available to consumers who would not otherwise have access to it. If market intelligence indicates that this type of market segmentation exists for a particular product, the enterprise may wish to present alternatives to its engineers and financial analysts for comparative purposes during plant design.

Financial factors. Quality is achieved at a cost. Therefore quality standards must be selected with this cost in mind and the related premium in the market for the standard in question. Although the analyst will not be in a position to perform the required marginal cost-benefit analysis, until work actually begins on designing the processing plant, it is essential during the stage of product definition to know the market premiums that relate to the standards being considered and to understand how meeting these standards will affect processing costs.

Packaging. The customer perceives the package as an integral part of the product. Technically, the package has three main purposes: (1) to protect the product, during transport, distribution, retail sale, and storage; (2)
to provide information about the product, what it consists of, how to use it, ingredients, and so on; and (3) to provide a service for the consumer, for example, by adding product features such as a spout, a “child-lock” on the cap, a resealable device, or a cap that can act as measuring cup.

These factors can greatly influence the customer’s purchase decision. A knowledge of the characteristics of the target market will enable marketing personnel to develop packaging that has the most positive effect on the purchase decision. This knowledge is essential if packaging is to serve its other important function: (4) to persuade the consumer. The package should induce a positive response when the customer makes the associations that research shows to be related to the product.

An agribusiness exporter from a developing country may be unable to meet the retail packaging standards of a food product group in a particular market because the packaging technology and packaging materials are unavailable in the exporting country. However, the exporter can ensure that the wholesale package conforms with the requirements of the distributive sector in the importing country. Some of these requirements are illustrated by the following two examples.

Example 1

Food traders in North America and Europe do business in terms of “cases” of product rather than individual product units. Thus, in trade parlance, the cost of a particular brand of canned pineapple is expressed per case. Most canned pineapples are packaged in standard-size containers and cartons. If a brand does not conform to this norm (e.g., if it was packed in larger than normal cans and boxes), there is a risk that it may be perceived as a “higher-cost” item than its competitors, even though the price per unit of weight or volume may actually be lower. Odd-size containers and cartons are also a nuisance and create a cost burden for intermediaries.

Example 2

A supermarket chain may retail as many as 25,000 different items in each store. What starts as readily identifiable pallets of a product at the central warehouse, breaks down to what may be only a few cases of product per store for low-volume items such as imported specialty foodstuffs. Not surprisingly, such cases can be lost among the myriad of brown cardboard cartons in the storage area at the rear of a retail store. A distinctive wholesale carton (e.g., brightly colored, product name in sharp contrast to carton
color) makes it easier for the wholesaler and retailer to identify the product and ensure that it reaches the store and is placed on the retail shelf.

LABELING. Many countries impose complex regulations on the labeling of food products. The intent of the regulations is to protect the purchaser, but some countries also use them to keep imported products from entering the market. Exporters should ensure that all regulations have been satisfied and, preferably, that labels and packages have been approved by importing regulatory authorities long before the first shipments are made to that market.

For the exporter shipping a processed product that is to be used as an input by a food manufacturer, detailed attention to the manufacturers’ shipping container and packaging requirements will ensure that the product is differentiated from the mass of competing products. Providing the customer with the right box or drum liner, size of unit, and product information on the package can be the deciding factor in securing and retaining an account.

Labeling has become an important aspect of standards. If an enterprise fails to comply with labeling requirements, authorities can refuse to permit it to distribute the product. In 1988, for example, failure to comply with labeling requirements was the second largest cause of import detention in the United States.

Labels normally have to indicate the ingredients, net weight, and origin. Many countries specify the language, units of measure, and printing to be used. International standards for most aspects of labeling food products have been developed over the past 20 years through the Codex Alimentarius, sponsored by the Food and Agriculture Organization and the World Health Organization of the United Nations. These are a useful guide for planners, but the actual requirements for each product and market must be verified.

Although nutritional information is not as widely required on labels as on some other items, an increasing number of consumers are insisting on this information, and they respond well to clear, comprehensive statements about nutritional value.

DEGREE OF PROCESSING. Marketing may take place at various stages of processing between the raw material and the finished product. Most international trade in coffee, for example, takes place in “green” coffee, which is a stable form of dried coffee beans produced near the coffee-growing area. Subsequent stages in processing include blending, roast-
ing, grinding, and packaging, and these may be performed by more than one specialized processing firm.

Beyond the traditional degree of processing, consumers may want processors to perform additional preparation, formulation, and cooking activities that had earlier been done in the home. Soluble coffee, for example, emerged as a whole new industry based entirely on consumer convenience. The appropriate degree of processing will depend on certain physical, financial, managerial, and socioeconomic factors.

In general, the more that a product is processed, the more it offers the buyer in terms of convenience and standardization. Shelf life may also be extended, but here there are some significant exceptions. For example, most refined vegetable oils are more likely to develop free fatty acids and become rancid than are raw oils, because the refining process removes their natural oxidation inhibitors. Special storage and handling may also be required to protect products that are more susceptible to physical damage as their degree of finish increases.

The engineering and financial analysis of the processing activity cannot proceed without an idea of the degree of processing that will be required for alternative products and the resulting volume and price differences in their respective market segments. Differences in market structure and competition for each should also be noted.

Investment in further degrees of processing is usually capital-intensive, and it will take a number of years to amortize such investment. To prepare market projections for this longer period, we must look beyond the general tendency of consumers to demand greater degrees of processing in their agro-based purchases, and of industries to become more specialized; we need to assess the market characteristics of the particular finished product we anticipate producing. Is the finished product the type that will have short-term consumer appeal—as a fad—and thus have a short life expectancy? Breakfast and snack foods are examples of finished goods made from similar intermediate materials that experience rapid changes in demand. In contrast, the demand for the flour from which they are made is relatively stable.

SELECTING THE PRODUCT MIX. The entrepreneurial intuition on which an investment proposal is initially based is usually centered on a particular product. However, it will be clear from the discussion of product selection up to this point that an enterprise seldom achieves the best possible financial performance by producing a single product. What may
have looked like a single product at the outset usually turns out to be a number of products, depending on the processing and packaging chosen for a particular market and raw material supply. For example, canned, sliced pineapple appears to be a single product. From the point of view of the processor, this is in fact a large number of products, depending on the choice of can size, label, and type of fluid (sugar syrup or own juice). In addition, now there are shrink-wrapped and vacuum-packed plastic containers for this product, both of which offer greater consumer appeal and some of the same preservation features as cans. The range of products that can be produced from similar inputs for similar markets is so broad that choices will have to be made if processing and marketing operations are to be manageable. At least three market-related factors merit close attention in selecting the product mix: competition and price, user appeal in different market segments, and product lines and brand recognition.

**Competition and price.** The strength and stability of the competition, as well as the margins to be realized, will vary from one product to another. This may be particularly true with respect to products that differ in quality, degree of processing, or packaging. Variations will certainly occur among retail, institutional, and industrial markets. Each market segment should be examined to identify the opportunities that best suit the cost structure and market links of a proposed enterprise.

**User appeal in different market segments.** Once the analyst identifies markets that appear to have attractive competition and price conditions, the next step is to determine the factors that influence purchasing decisions in those markets and relate them to the circumstances of the processing unit. If use patterns vary among the market segments the enterprise is interested in, then placing the same product in different size packs is one low-cost dimension in which to define a range of products. If price is an important consideration, the enterprise should investigate the possibility of using different grades of raw material and different packaging and labeling materials for the different qualities of goods that pass through the same process in the plant.

If the value of the raw material under consideration is relatively high, perhaps by virtue of its scarcity, then consumers at different income levels could be offered different degrees of processing so as to take advantage of the culls from fresh packs to produce frozen and canned products, or to blend small portions of the basic raw material with other ingredients into prepared foods. These alternatives differ from others mentioned above in
that they require different processing equipment and therefore involve greater capital cost.

Product lines and brand recognition. Consumers are loyal to certain brands of products because of their perceived value, which derives from a combination of quality and price. The same phenomenon is found among users of industrial products, although here dependability of supply is also an important consideration. Market development efforts can be more effective if the common denominator—the name of the product—can be promoted in a range of sales decisions. These trends in user purchase decisions point to the advantages of offering a number of related products to users under the same brand name. If an enterprise does not plan to market under its own name, it can still make itself more attractive to intermediaries by offering them the same advantages in more than one intermediate product.

Place: Choosing the Right Channel for Market Entry

A marketing channel is a set of institutions that perform the activities required to move a product and its name from producer to the final customer. The agribusiness must select the right combination of elements for the marketing channel if it is to attain its marketing objectives. All too often, this decision is taken casually. After the initial decisions, the choice of marketing channel may only be reviewed if the export program is clearly a failure, but it should be reviewed systematically.

Determinants of the choice of market channel. There are two reasons for such seemingly uncommercial behavior. First, the only source of market information for many export organizations is the agent or distributor located in the export market, and therefore objective evaluation is very difficult. Second, in the period prior to the first export shipment, the exporter may have made a legal agreement with a firm to represent the interests of the exporter exclusively, and terminating such agreements can be difficult and expensive. The choice of market channel should not be a matter of hit and miss. A number of factors should be taken into account:

- The channel must end at a point in the market that is consistent with the product's target market. For example, the food service sector (hotels, restaurants, institutions) has specific marketing intermediaries—brokers, wholesalers, and so on, who service only this
sector. If the product is targeted for the food service market, it should be channeled through sector specialists. If one product is targeted for more than one market, each market is likely to have its own distinct marketing channel requirements.

- The channel must reflect the nature of the physical product. For example, the more perishable the product, the shorter the channel, and the fewer the intermediaries. Specialized storage and handling equipment may also be needed in these channels.

- The channel must exercise the appropriate degree of control over product movement and the level of marketing services. For example, an export firm may wish to relinquish all responsibility for its product at its factory gate (ex-factory), in which case an export agent, trading house, or export marketing association might take over all distribution responsibilities from that point. At the opposite extreme, an exporter may elect to retain control over the ownership and distribution of its product to ensure product quality and delivery time or to capture additional margins in the distribution process. In this case, it will engage agents only to provide specific facilities and services.

- The channel must have adequate resources (capital, facilities, and personnel) to implement the desired marketing program. Smaller producers may hope to maintain maximum control over the movement of their products to the point of final sale, but the commercial reality is that shortages of working capital, facilities, or administration and sales personnel may force them to select a distributor that takes possession of the product at the port of entry.

- The channel must conform to legal constraints in the market country. For example, some centrally planned countries do not permit marketing companies to operate that are wholly owned by the producer of the goods being marketed.

In the final analysis, the exporter must choose from what is available. For example, if the only, or the preferred, freight carrier is also in the distribution business in the export market, availability of freight space may be contingent upon the transport carrier undertaking distribution services in the export market itself.

**SOME ALTERNATIVE MARKETING CHANNELS.** Several kinds of marketing channels are available to exporters.
1. An exporter can choose a marketing enterprise based at the point of production to represent its interests in the export market. An export agent or cooperative marketing organization will generally handle the export product from a central point in the supply country through to export sale. The organization can perform such tasks as consolidating freight and negotiating a rate, conducting market research, obtaining credit information, and establishing uniform contracts and terms of sale. It can also give the individual seller more countervailing power when dealing with large buyers in market countries. Export merchants or trading houses may also be located at the point of origin, and they will do more than represent an interest; they take title and therefore assume all commercial risks associated with exporting.

2. The exporter can elect to control its export operation from its home base via its own export division or department. This option is most likely to be selected when a firm is processing relatively few products and is servicing only a few customers with materials that the customers will further process (e.g., fruit pulp or juice being sold to a large blender in an export country).

3. The exporter can select representation based in the market country. This is the most common arrangement. Firms that distribute imported products perform numerous specific functions, but for purposes of discussion they can be grouped into two main categories: the importer or distributor, who takes title to the product and then moves it through the distribution system to the point of final sale; and the agent or broker, who represents the products of other firms and, typically, handles noncompeting products. The agent usually works an exclusive sales territory and does not take title to the product but negotiating contracts between buyers and sellers (i.e., the exporter finances the inventory costs and any other marketing costs). The rate of commission will depend on the type of product (e.g., specialty, "main line," high or low volume) and the type of marketing services the agent or broker provides, but in general it will range from 5 to 20 percent. Typically, a broker will seek products with high-volume potential and/or products that will complement a product line already carried.

Whether or not an agent/broker or importer/distributor handles an imported product, a wholesaler may participate in the distribution of the product. If the product is destined for sale on the retail counter, the wholesaler (often servicing independent retail outlets or small chains) can offer the equivalent functions provided by the headquarters of a major
In planning the marketing program, the exporter should anticipate questions that large retail buyers will ask of the wholesaler or other distributor concerning the product. For example,

- What sales category is the product in (e.g., specialty, delicatessen, dairy)?
- What is happening to this category at the retail level (e.g., demand is growing or stable)?
- What other products are in the category (e.g., are there clear market leaders)?
- What are the unique features of the product (e.g., spicier, additive-free)?
- How does product quality compare with others in the category?
- What impact would rapidly increasing sales of the product have on competitive and complementary products carried by the retailer?
- Are there any test-market results to indicate the level at which product sales are likely to increase rapidly?
- Is the packaging consonant with consumer wants (e.g., is it tamper-proof, convenient)?
- What is the target market?
- Does the distributor have a customer trial promotional strategy?
- Are retail competitors carrying the product and what have the sales results been?
- What kind of reputation do the product manufacturer and the broker or distributor have with respect to quality, price, and consistency of supply?
- What is the lead-time for product placement?
- What, if any, is the promotional strategy outside the store (e.g., television, newspapers, magazines, direct mail)?
- What marketing channel has been used to bring the product to the store level?
- What promotional and other new product trial allowances are offered to the retailer?
- Does the distributor guarantee a certain level of sales?
- What are the recommended pricing points; that is, how should the product be priced against other products in the category?
- What is the expected level of profit for the retailer?
• What credit terms are offered?
• What significant in-store labor requirements must be met to retail the product?
• Does the product and its sales program fit the supermarket merchandising plan?
• Has the distributor purchased adequate public liability insurance?
• If the product is to be imported, has it satisfied all regulatory requirements (e.g., FDA approval for the United States)?
• Does the product have a Universal Product Code (UPC) for ease of price-scanning and inventory control?

Many of the questions listed above are also relevant if the product is being sold into the food service sector, where market channel participants tend to specialize in food service clients alone. Unit sizes, packaging requirements, and other elements of the marketing mix in this sector will differ, often substantially, from those of the retail sector.

The challenge for the food product exporter is to select participants in the marketing channel who are willing to offer a level of commitment to the exporter that goes beyond simply adding yet another product to an already large pool. Commitment is not given freely, it must be paid for or earned:

• The exporter can pay for the commitment by offering a high rate of commission on sales or, indirectly, by inducing a personal interest in the business on the part of the distributor by paying for visits to the point of production.
• The exporter can gain commitment by providing a product that complements a distributor's existing product line and therefore strengthens the distributor's competitive position when selling to large customers.
• The exporter can take particular note of the wants of the distributor and retailer, for example, by coordinating product movement to meet their specific requirements or by providing a wholesale package that is consonant with the distributor's product handling system.
• The exporter can foster commitment by providing consistent, reliable supplies of a high quality product.
• The exporter can build commitment through a formal joint venture with a market-based partner, in which the profits emanating from the entire export program are shared in an equitable manner (e.g.,
by reflecting the level of risk taken by each party or marketing services provided).

**EXPORT MARKET DOCUMENTATION.** Firms with limited export experience may fail to appreciate the importance of documenting exports in the marketing program. Taking up this issue as an afterthought can spell commercial disaster. Marketing managers and the export program analyst should ensure that the organization has the administrative capability to design, install, and maintain the required documentation systems.

Doing business at long distance creates a myriad of opportunities for miscommunication. Any export organization will be at a serious disadvantage if it does not have at least one, but preferably all three, of the following facilities: telephone, telephone facsimile transfer (Fax), and telex communications.

The most important details to document are customer orders and sales, shipment procedures, clearance procedures, payment and post-shipment procedures, and insurance and claims procedures.

An important point to bear in mind when designing the documentation systems is that they should be market-oriented; they should meet the requirements of the buyer(s) first, and, second, they should satisfy the exporter's own internal administrative requirements.

**Price: The Delicate Balance**

Most agroindustrial enterprises sell to markets in which they are "price takers"; that is, they do not have a large enough share of the market, or the market is not sufficiently independent of other products, to afford a wide latitude for the enterprise to set the price of its product. Despite this general condition, there is usually a range in which the seller can adjust prices on the basis of product differentiation, cost structure, and corporate financial policy. In determining the price of a product, an agribusiness enterprise should take the following steps:

1. Establish marketing objectives (e.g., maximum market share or maximum returns per unit sold).
2. Estimate demand for the product, that is, sales volumes at alternative price levels.
3. Determine unit costs at different levels of output.
4. Review the prices of competitive products.
5. Select the pricing method (e.g., cost-plus, target-profit pricing).
6. Select the final price and check that it is acceptable to members of
the marketing channel (and the government, in the case of con-
trolled prices).

In practice, not all these steps are necessarily followed, at least not the
second step, since the assessment of demand elasticities and competitors’
responses in distant markets may prove too costly and difficult for the
exporting firm. Historical data and seasonal fluctuations of price and vol-
ume may be a useful proxy for detailed price elasticity information.

Many exporters of basic, unbranded food products destined for fur-
ther processing and packaging determine price only on the basis of the
supply and demand of the commodity on the day a deal is struck. In this
case, commercial survival depends on cost competitiveness, although sat-
isfying customer wants for service surrounding the physical product is
still vitally important. Agreements with potential buyers will center not
so much on price—which will reflect open market conditions—as on
deliveries, quantities, and qualities. In the short term, a reasonable esti-
mate of product price can be made by checking prices for equivalent
products. In the longer term, such price assumptions are less robust
because future prices will reflect supply and demand conditions that are
difficult to predict. However, management and analysts can gain comfort
from knowing that, at a minimum, the bulk product will find a buyer
even if it is less than published price levels, if the quality and quantity
standards of the export market are met.

In checking the validity of the price assumption, the marketing analyst
should contact potential buyers who have expressed an interest in the
product in order to discern their level of commitment, the level of antici-
pated orders, and their view on future market movements. The analyst
should also solicit the views of others in the same industry sector on the
marketing outlook for the product and its competitors.

The exporter focusing on retail food markets has more latitude with
regard to establishing price if he has segmented the potential market cor-
rectly in relation to the product, selected an appropriate target market,
and then positioned the product correctly in the perception of the cus-
tomer. Of course, the product must live up to the customer’s expectations.
One of marketing management’s primary business goals should be to dif-
ferentiate its products from others to reduce competitive pressures on
price.

Having differentiated the product, management must ensure that the
price selected for the product is consistent with the other elements of the
marketing mix. For example, if the product is positioned to appeal to an “up-market,” high-income clientele that is interested in gourmet products, the price should reflect this. Certainly, in North America, Europe, and Japan, price is perceived as an indicator of quality for many products. Consumers are willing to pay for quality and want to show others they are willing to do so.

It is an accepted practice among the middle- to higher-income consumers in North America to take a bottle of wine to a friend’s house if invited for dinner. Almost invariably, consumers will purchase a bottle of wine that is more expensive than the product they would consume in their own home — this action reflects complicated reasoning that goes something like this: “We like you,” “we like wine,” “we have a sophisticated wine palate,” “we know good wines,” “you are worthy of good wine,” “you know good wine,” “we wish to conform”!

It is more difficult to establish a price for branded products than for unbranded ones. Concomitantly, the risk that an export program will fail is higher for a branded product, although the potential payoff can also be higher.

The task for the market analyst charged with checking the validity of the price and sales volume assumptions for the branded products is four-fold:

1. Discuss the rationale for price and sales volume projections with the export marketing management.
2. Contact potential buyers and ascertain their level of commitment and their view on product prospects. It is unlikely that a binding purchase order will be received at this stage. As a next best indicator, the analyst should review correspondence between buying and selling parties to form an opinion on the likelihood of a contractual agreement.
3. Discuss product prospects with objective trade members in the export market who have knowledge of the target market. Remember to treat with caution trade responses on ill-defined product matters.
4. Synthesize the information collected and make a decision.

The following are some additional pricing questions that an agribusiness manager should be able to answer before implementing an export program:
• Are prices regulated in the export market? By whom and at what level? This is generally not a concern for products targeted at North American and European markets but may be extremely important if the target market is in a developing or centrally planned economy.

• Is it necessary to price the product at relatively low levels to overcome the initial barriers to entry? One problem with this strategy is that it will not be easy to raise the price to a profitable level in the future after the new customers and distributors have become accustomed to the initial price. Indeed, it will be very difficult to make up lost margin with higher market share.

• Is there an industry price leader and if so, where, in the customer's mind, would the export organization's product fit in relation to the leader?

• What information is available on the past pricing strategy of likely competitors? How did the price leaders respond?

• Are any market or technological developments expected in the future that would significantly alter the price basis for the product range?

• Are there opportunities for long-term supply contracts at preestablished prices (particularly if there have been historic problems with supply variability)? And if prices are set on a major commodity exchange, what opportunities exist to “lock in” a price through hedging on a futures market?

Finally, the exporting enterprise should ensure that the price established at the export market point translates back to at least the net ex-factory price that is required to meet its financial objectives. Particularly if the distribution chain is long and if the food product is being newly introduced to the market, the new exporter will find an alarming number of deductions for marketing services that whittle down the final received price to less than was initially expected.

Promotion: Persuading the Customer and the Distributor

Product promotion consists of four basic activities: (1) advertising, which is the nonpersonal presentation of information, paid for by the sponsors, about a product and directed at potential or present purchasers; (2) sales promotion, which comprises short-term incentives to increase the sale of a
product; (3) publicity, which occurs when information about a product is presented in a published or aired medium and the presentation is not paid for by the sponsors; and (4) personal selling, which is the face-to-face presentation of product information by a representative of the manufacturer or distributor for the explicit purpose of making sales.

The effectiveness of the promotion program will depend on whether its different functions are complementary. An ad hoc approach to promotion overlooks this interdependence and is therefore much less cost-effective than a program developed as part of a marketing strategy. The analyst can determine which approach an exporter has adopted—ad hoc or strategic—by asking senior management to describe the principal elements of their promotional strategy.

There are eight major steps in developing a promotional strategy:

1. Identify the target audiences and determine how (if at all) they perceive the product. Almost certainly there will be more than one audience (e.g., final consumer, broker, wholesaler, retailer, or specialist broker, chef, and food service manager).
2. Develop promotional objectives (what will be achieved as a result of the promotional programs?). These could be, for example, a specific sales increase, or increasing awareness of the product to a specified level among major distributors.
3. Articulate the promotional message (what will be said and to whom?).
4. Identify the communication channel to be used (e.g., direct sales call, direct mail information sheet to wholesalers, radio commercials).
5. Set the promotional budget.
6. Decide how the budget will be spent (e.g., how much on direct mail, sales calls, radio and TV commercials).
7. Monitor the results of the overall program.
8. Adjust the promotional program to maximize its impact by shifting resources toward elements that are generating the best results.

DIFFICULTIES IN THE USE OF ADVERTISING. “Advertising”, a term that is mistakenly used as a synonym for promotion, is frequently the least used of the four promotional tools for products from a developing country source, and for good reason. Advertising can be very costly; even at a minimum level it can be beyond the financial resources of many firms.

It is also very difficult to determine rationally the appropriate expenditure on advertising, particularly in foreign markets. Even relatively
sophisticated firms in developed economies often have only a vague idea of what their advertising budget should be and they resort to rule-of-thumb measures such as “2 percent of sales.” The reason is that the effectiveness of advertising is extremely difficult to measure. Many constantly changing variables in the marketplace serve to obscure the measurement of cause and effect.

For an agribusiness selling a product that is to be further processed in the export market, advertising in trade magazines is unlikely to be an effective means of promoting a product. The customer base is probably small enough to permit direct contact, either by mail or in person. Trade fairs and conventions provide useful opportunities to capture the attention of potential buyers, either through personal contact or a rented promotional booth.

The dilemma for many developing country firms seeking to advertise their products in foreign markets is that advertising is an investment requiring up-front financing; the advertising agency has to be paid in foreign exchange well before revenues are generated from the sale of the advertised product. As a result, it is usually necessary to institute an alternative promotional strategy, which begins by focusing on lower cash-cost sales promotion, publicity, and personal selling. Then, as the product edges into the market and sales revenues are generated, an advertising program can be introduced. Therefore, promotional programs for export food items from developing countries should not be high-profile “pull” campaigns that seek to communicate with consumers and to persuade them to look for and ask for the advertised item. Rather, the promotional focus should be of the “push” type; that is, the distributor and retailers of a product are exhorted and given incentives to promote it to the final consumer.

Summary: The Marketing Strategy

The marketing strategy is the “game plan” a business organization uses to attain its marketing objectives. The strategy provides senior management and investment project analysis with a synopsis of (1) the target market and the proposed position of the product(s) in the mind of the target purchaser; (2) the product—its physical nature, major components, features and services, product packaging and brand name; (3) price tactics and pricing structure; (4) distribution channel(s) and marketing channel incentive structure; (5) promotional expenditure and focus (e.g.,
advertising, sales promotion); (6) merchandising and sales aids, training and experience of sales personnel; and (7) marketing performance, monitoring, and ongoing market research activities.

Management should be able to present its basic marketing strategy concisely on no more than one page. However, marketing activities must be planned in detail by expanding each strategic component of the marketing program with respect to what is to be done, when, by whom, and at what cost. The marketing manuals that managers use in implementing an export program should articulate the strategy in operational terms.

Evaluating Marketing Strategy: Some Critical Questions

Certain marketing questions are fundamental in the sense that their answers give a picture of the basic strength of the marketing strategy. These are discussed in the following paragraphs.

- Has senior management of the enterprise made a commitment to expend resources to the level that is envisaged in the marketing strategy?

The strategy should be the blueprint for what the enterprise intends to do, not a hypothetical statement that looks good on paper and reflects the optimum outcome if everything turns out right. Management must believe in the strategy and have control over its development and final form. Too often, the potential exporter sees the strategic rhetoric in the feasibility study or business plan as a means of securing investment finance, rather than a statement of what it intends to accomplish in the export marketplace. This is particularly the case if the marketing strategy has been crafted using external consultants, for example, when an aid agency or export development agency providing technical assistance has significant input in its authorship.

- Does the marketing strategy make good commercial sense? That is, is it coherent and can the organization do what it says it is going to do?

In part, these questions can be answered by reviewing the past record of the enterprise, assessing the competence of the management team, and determining if the various components of the marketing strategy reflect a sound assessment of market conditions, the product, and the resources of the enterprise.
Is the marketing strategy compatible with the overall business strategy?

The marketing strategy must be consistent with the financial, organizational, production, and procurement components of the business plan. Although the export program should be market driven, all levels of the organization should be capable of meeting the exacting requirements of the target market in terms of quantity, quality, and reliability of supply.

What are the main marketing assumptions and are they valid?

The variables that should be included in an initial market feasibility test were presented earlier in the chapter. An export product should never be launched prematurely. Most important, management and investment analysts must have a clear idea of who is going to purchase the product, in what quantities, and at what price? Checking on the assumptions on price is, arguably, the most critical and difficult task for the marketing analyst. Invariably, the analyst will have imperfect information and will have to base the assessment in large part on the astuteness and intuition of the potential exporter. The more of its own money the exporter has at risk, the more carefully it should have thought about expected prices and volumes.

Has the product been test-marketed with the potential final consumer?

Such tests provide essential information, not only on purchaser or consumer acceptability but also on whether or not the product meets the regulatory requirements of the export market and, on a very small scale, on the ability of the marketing channel to deliver the product to the point of sale.

Is the marketing implementation schedule realistic?

It takes longer to achieve target sales levels than many marketing managers expect. Some combination of lower-than-expected prices and lower-than-expected sales volumes are responsible for targets not being met. Generally, if sales targets are not met for unbranded bulk products (e.g., juice concentrates for blending or packing at the export point), the problem is supply-based; there are raw material shortages, processing problems, or difficulties in the delivery system.
Supply-based problems can also affect the performance of the exporters of branded products, but they have the added challenge of sustaining market penetration. A reputable distributor should not take on an additional branded product unless it is assured that the product will be available in the quantities and at the quality promised. The distribution firm does not wish to disappoint its customers and will be concerned that the exporting firm has promised too much. As a result, introducing a new product, particularly from an offshore source, takes more time than most managers expect, and it is only with time that distributors and their customers may become more comfortable with the supply capability of the exporting firm.

- Is there a strong marketing management plan?

Specifically, who is responsible for doing what in the marketing program? In smaller firms, the most senior management personnel are also, typically, owners of the enterprise. Middle management is limited in such firms and decisionmaking is highly centralized. The most common problem is that senior managers become overstretched, and crisis management prevails. Launching an export program in an organization in which crisis management is the norm is not conducive to commercial success.

It is useful for senior management to list all the activities that make up the export marketing program and to note alongside each activity who is responsible for ensuring that the activity will be completed and the deadline. Frequently, this exercise reveals that a middle manager stratum must be established if the program is to be implemented successfully.

- Are contingency plans in place in case the marketing system should fail?

The only thing that is certain about implementing an export program is that something will go wrong! There must be back-up plans for the failures that are bound to occur at critical points along the marketing system and that may threaten the entire success of the export program. For example, a spare generator should be on hand in case of prolonged power failures, and own or hired transport should be available in case the regular transport carrier fails to arrive.

- Has a system been developed for monitoring export product performance through the marketing chain and for providing market intelligence on the export product and its competitors?
Too many exporters ship out their product and hope for the best! Product monitoring and ongoing market research activities have three important uses. First, they provide the means to determine how the export program is performing in relation to preestablished objectives. Second, contact with the marketplace and individual marketing channel members is an essential part of the after-sales service. Third, the marketplace is dynamic, and competitive product profiles will change constantly. It is essential to have an objective view of what is happening in the marketplace, the arrival of new products that will have an impact on demand for the export product, and the pricing of the export product at various stages along the marketing chain.

Conclusion
Launching even a small export product may consist of as many as 80 essential activities that must be implemented in a preestablished sequence, taking one year or more to complete from start to finish. Listing such activities brings home clearly that marketing involves every function of a company. The marketing team includes the company’s procurement, production, and financial personnel, in addition to the staff in the marketing department. Everyone in the organization is in the business of satisfying consumer wants with the company’s products, at a profit. This is the essence of the marketing approach.
Appendix. Developing a Marketing Strategy: A Case Study

This case study illustrates how to plan the development of an export market. The hypothetical Fortex company has advantages that may make the task seem deceptively simple: It is already in business and in the export trade, it has an existing and trusted distributor, can capitalize on an existing product base, and has a processing capacity that can be expanded without a large investment. But the company is also asking the right marketing questions.

Fortex Foods Inc. is a family-owned and managed food-processing plant in a Central American country. It produces a range of processed vegetable and sauce products, and its market focus is on domestic sales. The company has one export line: a 1-liter plastic bottle of hot pepper sauce for sale to the Hispanic food service trade in Miami and southern Florida, in the United States. The company draws raw material supplies from its own farm (largely hot peppers and herbs), supplemented by contract purchases of fresh vegetables from a network of farmers in the immediate vicinity. The export line is consigned to Miami, by sea, and distributed through a food service wholesale company near West Palm Beach.

The distribution company was recently acquired by a larger firm that operates a chain of food service wholesalers throughout Florida. This new family of companies is targeting both the local ethnic trade and the tourist trade in the southeast Florida, Tampa, and Orlando markets.

Fortex is eager to expand its U.S. export business but is experiencing difficulty expanding sales volume and value because of competitive pressure from other Latin American and Caribbean hot pepper sauce imports, as well as domestic products from Louisiana. Expanding out of the food service sector into the supermarket trade is not considered feasible; supermarket shelves carry many similar products and a retail product launch would be difficult and expensive and would have a low profit margin. Fortex is seeking a less price-conscious target market that has less competitive pressures and offers the opportunity to establish a branded product at lower product-launching cost than at retail. The company is encouraged that the present distributor of its export product has been asked to find new products that can be distributed exclusively to both the ethnic and tourist food service sectors.

At a Fortex board meeting, family members active in the business have agreed on an amended company goal: to increase the share of export business in overall sales and net profit contribution for the firm. The
directors have asked the marketing manager (son of the chairman) to present proposals to the board for expanding export business.

The first step of the marketing manager has been to identify the strengths of the company:

- It is in a sound financial condition and has a good relationship with its bank.
- It has good access to raw material supplies from the company farms and contract growers.
- The processing plant has several product lines that are stable and that generate good cash flow, particularly its sauce for local sale and hot pepper sauces for local and export sale.
- The plant has spare capacity and can expand output without substantial new investment.
- In the export market, it has a good working relationship with its distributor.
- Products from this Central American country have relatively unimpeded access to the U.S. market.
- The plant is already meeting the U.S. Food and Drug Administration regulatory requirements for processed food products.

The marketing manager believes that a visit to southern Florida would help the company to determine what market opportunities match its capability and strengths. In any event, the visit is necessary to meet the new owners of the expanded distribution company, to ensure its loyalty in distributing the hot pepper sauce product.

*Market Reconnaissance*

The marketing manager for Fortex travels to Miami to meet its distributor and senior managers of the new parent firm. The parent distribution firm expresses particular interest in establishing "exclusive product lines" with its existing suppliers as a means of safeguarding its present customer base and expanding market share in the food service business. The parent company has strengths in two market areas: the Latin American and Caribbean ethnic trade, particularly the small ethnic food service operator, and tourist food service outlets in "up-market" hotels and restaurants. The former market is characterized by owner-operators who, while quality conscious, cater to lower-income families whose meal expenses per customer are relatively low, and for whom cost control is of
paramount importance. The latter is characterized by relatively high meal charge per customer and, although still conscious of the need for cost control, operators in this market are constantly searching for food product inputs that will differentiate their menu from that of their competitors. They require a consistent level of product supply and quality.

The marketing manager sets aside four days to canvass the views of the food service trade about products that Fortex is producing or could produce. Existing customers for Fortex's hot pepper sauce like the product but, in general, make it clear that competitive price is the basis on which they maintain their loyalty (i.e., if it is at or close to the price of other hot sauce products, they will continue to buy the Fortex product). In addition to hot pepper sauce, they purchase other sauce and seasoning products but complain that these are frequently not available when they want them, and they are nostalgic about seasoning products "back home" that are not available on the market in the United States.

The marketing manager notes that there can be two barriers to sales at the tourist hotel and restaurant level: (1) food service managers are very concerned about the cost of the product per serving, delivery schedules, and invoicing terms; and (2) chefs are more concerned about creative products that could be used to prepare interesting meals.

Both stress, however, that menus are set well in advance of the main tourist season (December-April) so that the food budgets can be submitted to senior management and menu cards can be printed. The marketing manager asks the chefs what types of sauce and seasoning product are most frequently purchased, what packaging, and the unit costs and notes that what he would consider to be a mild (even bland) sauce product is perceived as being unacceptably "hot" for the customer base of many restaurants. Further, food costs as a proportion of the total meal charge generally do not exceed 30 percent, and most seasoning products form a small proportion of total food costs. However, chefs are enthusiastic about using pre-prepared seasonings and sauces.

Back at the hotel, the marketing manager makes some notes on what he has learned about the food service business in Florida. A surprisingly high proportion of menu items in tourist restaurants have labels such as "creole," "cajun," "Caribbean," and "Mexicali" and are generally linked to fish and chicken meals, and although mildly spicy, are not "hot." He surmises that the customer wants an unusual eating experience that is more exotic in name than in taste—the tourist wants some epicurean excitement but is basically conservative. Of course, there are exceptions
and, like the ethnic customer, some tourists seek the "real thing," that is, "hot," spicy food that is reminiscent of long-recalled meals eaten in Latin America and Caribbean countries.

For the tourist food service sector, the marketing manager identifies the following preferred attributes of food products:

- Easy to adapt to existing dishes or menus.
- Not available at present and provides the chef with an opportunity to add interest to the menu, without frightening the customer—that is, appeals to a wide range of the restaurant's customer base.
- Easy to use and takes little time to prepare.
- Easily stored and identifiable in storage.
- Long shelf life with little deterioration.
- Consistently available at short notice.
- Pack sizes reflect kitchen usage patterns.
- Modest cost per serving.
- Guaranteed consistency of quality.
- Innovative ideas provided on product use.

Interestingly, he notes that ethnic food service operators and tourist restaurants seek a similar range of product attributes. Both groups indicate greater interest in food products that are expressly directed at the food service trade; that is, products with "chef pack" or "restaurant pack" promote interest and purchase loyalty.

For the distributor, the important product attributes seem to be the following:

- An exclusive, attractively packaged ("packed exclusively for XYZ Inc.") food product that is not currently available and appeals to a high proportion of customers.
- Does not compete with, but complements, the existing range of products.
- Is easy to handle and identify.
- Offers an opportunity for sales growth and a relatively high margin.

**Product Definition**

Next, the marketing manager reviews the product line of Fortex. The company produces a fish and chicken seasoning sauce, based on a mix-
ture of chopped herbs and spices, that seems to him to offer, a priori, potential in the market segments he has seen. Some adaptation of this product could satisfy the requirements of both the tourist and ethnic customer segments. Perhaps a mild version for the tourist trade and a “full-strength” version for the ethnic trade and the more adventurous tourist?

His initial rough calculations (determined after a long telephone call with his brother, the production manager for Fortex) indicate that the tourist food service trade could accept a portion serving cost of 25 cents (with 40 servings per “Chef Pack,” giving a delivered price per pack to the restaurant of US$10) and a portion serving cost of 5 cents less for the ethnic trade (using a lower-cost package). With an attractive margin for the distributor, there could be a respectable return for Fortex, if initial sales could be US$3,000 per month, rising to $25,000 per month (taking into account seasonal and other factors). Certainly, the chefs and food service managers had not objected to this cost per portion level and it seemed to be within the competitive range.

In discussions with the distributor company, the marketing manager notes that there is limited enthusiasm, as the distributor has difficulty imagining the product in the abstract. The company has no problem with his indicative price, which seems in line with potential competitive products, but the distributor suggests that when he returns home he should consider again the price structure, as a competitive price would be important at an initial market entry stage if the product is to become well established and reach the sales targets he postulates. Stopping only to buy some video games for his children at a mall close to the airport, he heads for home. The phrase “ever so tasty, not too spicy” revolves in his mind.

Back at Fortex, the marketing manager briefs senior management on the findings of his marketing reconnaissance trip. He makes a prima facie case that if the company adapted its existing spicy herb seasoning sauce for chicken and fish, it could satisfy the requirements of two export target markets and offer profit potential for Fortex. He makes an initial draft of marketing objectives and is keen to see the reaction of family members representing the raw material supply, production, and financial side of the business.

In general, management’s reaction is positive. Everyone acknowledges that freight should not be a problem, there are no unsurmountable barriers to market entry, and that supply-side constraints such as raw product procurement, plant capacity and adaptability, and increased working capital requirements should not seriously impede the proposed
export venture. They do express concern that the main assumptions about product price and sales volume should be checked rigorously.

In summarizing the meeting, the chairman notes that such a program would build on existing product strength, use a known and trusted distributor, and provide an opportunity to consolidate export shipments of Fortex products such that, with sales success, they would be able to use container shipment, rather than break-bulk or palleted shipments, and it presents an export opportunity with relatively low investment exposure. He asks that the relevant managers—procurement, production, finance, and marketing—prepare a comprehensive business plan that the directors can review at the next board meeting in three months.

In closing the board discussion, the chairman reminds managers that success in any venture, whether domestic or export oriented, requires close cooperation and coordination between the various divisions of the company. “Team work is all,” he says; “we must share the same commercial vision.”

The actual complexity of developing a new product and planning new export marketing ventures becomes evident the following day when the marketing and production managers sit down to outline the many and various tasks that are to be completed. The company has a marketing concept, but little else. The two of them have to prepare a strategy for developing some physical product alternatives for taste testing by target customers, along with packaging, labeling, and brand name concepts consistent with the product positioning strategy that is yet to be developed. Obviously, a return trip to the market area is essential, and samples of the product and, at the least, “mock-ups” of the package have to be presented to the distributor at an early stage to ensure continuing interest and commitment.

The managers consider their limited budgets for developing new products and doing marketing research but see no realistic alternative to using an advertising agency to coordinate product taste testing, package design, brand name testing, and formulating promotional strategy. The marketing manager plans a second visit to the market area to coincide with testing activity undertaken by the ad agency.

Time passed, money was spent, and progress was made. After developing acceptable products and packaging and after investigating and refining market estimates, the marketing manager called for a concerted effort from the senior managers to develop a comprehensive marketing strategy.
Marketing Strategy

The task for the marketing manager was to articulate a marketing strategy for the new export products. After close collaboration with his fellow managers, he spelled out the marketing objectives for the proposed export program: stipulated sales and profit targets by product item. A related task was to specify target markets, but who were the targets—the final consumer of the product, the user of the products in meal preparation, or the distributor of the product? The marketing manager felt strongly that all were important, but it was the wants of the final consumer that had to be satisfied fully or the program would be doomed to eventual failure. He summarized these wants in terms of the three major target customers:

- Tourists visiting a restaurant and seeking a meal experience that would complement their holiday mood, but that was still within the range of their relatively conservative taste expectations.
- Tourists wanting a meal experience out of the ordinary that supported the desired image of being knowledgeable about exotic foods, adventurous, sophisticated and cosmopolitan.
- The Florida resident with a Caribbean or Hispanic ethnic background who sought familiar taste experiences or recalled nostalgically the meal-eating experiences of a past time.

As for the physical product, satisfying the wants of the three groups translated into two types: An “ever so tasty, but not too spicy” version of the company’s herb and spice seasoning for use in food service outlets, for the more conservative tourist; and a spicier and “hot” version for the adventurous tourist and the local resident with a Caribbean or Hispanic ethnic background. Of course, the packaging, brand names, and other features of each product had been designed to reflect the different requirements of each of the target market consumer groups.

It was also necessary to direct the other essential component of the “product,” namely, the package, toward the target customer. For the food service manager, chef, and outlet owner, plastic, “squeezable” flasks were selected, with a controlled-portion dispenser, packed six per case, in a white cardboard carton, with the product name clearly identified on the case for the tourist consumer products—a green label was used for the mild product version and a green and red label for the spicier, “hot” version. The brand name was the same for both products, although the pre-
fixes "mild" and "hot and spicy" were clearly identified on the respective products. For the ethnic retail consumer, plastic tubes were selected, packed four per case in a brown carton, with a lower-cost label printed in both English and Spanish.

The distribution strategy statement was straightforward for each of the three products; that is, they were to be trucked by Fortex to the dock, shipped by sea by scheduled transport carrier to the Port of Miami, cleared at the point of entry, and distributed by the same distributor company as the hot pepper sauce.

The promotional objectives were twofold: to enter the market by encouraging trial use, and to expand the market by encouraging increasing frequency of use per product purchaser. The chosen promotional plan specifically provided potential purchasers with free-trial, full-size flasks or tubs with supporting sales literature stressing product attributes, ideas for meals, interesting meal titles (e.g., "Red Snapper Royale"). For the tourist products, a sales story was included that highlighted the more exotic aspects of the product's past (e.g., a Mayan seasoning dish that was traditionally associated with weddings and fertility rites).

The price for the tourist-directed products was to establish them as premium items but, on a cost-per-serving basis, as "profit enhancers" for the restaurant management. For the ethnic food service trade, the item would be priced close to other competitive sauces and seasoning products. The "mild" and "hot and spicy" version for the tourist trade were priced the same. Distributor margins were established at prevailing trade percentage levels, but the relatively high unit price per case provided the distributor with an attractive financial return. Sales terms were set at monthly delivery and 30 days net for payment to the Fortex bank account in West Palm Beach.

The marketing manager recognized that the "front-line" selling job would be undertaken by the specialty products manager of the distributing company and his delivery or sales team. As a result, the selling strategy focused on educating these key players about the unique attributes of the products and their strong profit potential for the company, and on appealing to the distributor's sense of corporate loyalty by stressing the benefits of giving an extra sales push to products that were "produced exclusively for the XYZ Co. Inc."

Providing Fortex management with ongoing market research information posed some problems. Being distant from the market, the marketing manager would be unable to track product usage at the food service out-
identifying, developing, and servicing markets

let level. Of course, sales invoices would show how Fortex sales were faring, but they would say little about competitive products. He would be obliged to obtain information from the distributing company’s specialty products manager and planned regular telephone contact for this purpose. In addition, he ordered the trade magazines that catered to the food service sector, both nationally and in Florida. Finally, he planned regular market visits to monitor Fortex and competitive product performance and to search for new market opportunities stemming from the launching of the seasoning product, such as adding new sauce and seasoning products to the “Chef Pack” range.

The marketing implementation schedule had critical time elements. The marketing manager intended to launch the trial packs of the export products in the second half of the tourist season (February-April). The goal was to achieve some repeat sales before the end of the season and then be well placed to initiate a food sales promotional program just before the tourist food service trade prepared menus in the May-June off-season.

After completing the marketing strategy, the marketing manager listed the tasks associated with each element, the individuals who were to complete them and when, and the estimated cost of completion. The draft of this document was circulated to his fellow senior managers for their comments. He was responsible for pulling together the various components of the overall business plan and for writing the executive summary that he would present at the next board meeting.
The Selection and Evaluation of Processing Options

Processing is an operation or series of operations performed on a raw material to change its form or composition. Processing can be as simple as cleaning, grading, and packing fresh produce or as sophisticated as using pure strains of enzymes to convert corn starch to high-fructose sweeteners.

Traditional agroindustrial processes evolved from society's need to enhance the usefulness of agricultural products. The two basic methods employed for this purpose are preservation and separation.

*Preservation* consists of converting raw materials to a form less subject to deterioration, usually through drying, curing, fermentation, refrigeration, or cooking. Some forms of preservation, such as fermentation and cooking, impart other desirable characteristics to the finished product that may become ends in themselves, but they remain essentially preservation processes. Irradiation and freeze-drying are the principal innovations in preservation during the past century.

*Separation* consists of isolating desirable components such as seed, oil, or fiber from the parent material occurring in nature. After the natural material has been disaggregated, usually through the application of mechanical force, separation is achieved by exploiting differences in the weight, specific gravity, size, air resistance, shape, or solubility of the components. The use of catalysts and solvents has been the principal development in this type of processing in the past century.
Developments in agroindustrial processing during this century have greatly changed the appearance and scale of these activities. For the most part, however, the purpose and the end product of such processing have remained basically the same; the changes were introduced to effect greater efficiency or greater precision. With the application of greater quantities of heat and mechanical force to larger quantities of raw material, the costs of processing per unit of throughput have declined, and efficiency has increased. The shift from batch to continuous-flow processes has also been an important step forward in this respect. At the same time, the development of techniques for achieving greater precision in the control of agroindustrial processes has made it possible to improve greatly the uniformity and quality of the end products.

In many branches of agroindustry today, the best processing choice remains the one that matches raw materials and markets in terms of efficiency and quality. However, some of the greatest agroindustrial achievements have also been due in part to two other factors: the search for convenience, and the development of new products.

Socioeconomic trends, particularly urbanization and employment specialization (and the consequent demand for convenience) have created a demand for greater degrees of processing before an agricultural product reaches its final consumer. This is most evident in the food sector, where refining, blending, cooking, and packaging have led to virtually new forms of industrial activity. The extent of these changes varies greatly among countries, but the trend is noticeable even in the least developed economies, particularly in urban areas.

Innovation in other areas of human endeavor, such as medicine and transportation, has led to the development of new products from agricultural raw material. In some cases, such as rubber for the tires of vehicles and ethanol for fuel, the related processes are based on traditional activities, and the new market has expanded total demand and shifted relative demand among various users of the raw material in question. In other cases, an entirely new product is the result of innovative research that cannot be put into commercial use without adopting a new and sophisticated technology. Chemical research has been a fertile source of new products such as high-fructose corn (maize) syrup, an isomer of glucose produced through the controlled action of enzymes. The chemical changes in these processes cannot be put to use commercially without adopting a more complex technology and greater quality control than are
typically employed with processes that evolved from a traditional activity.

Efficiency, quality, convenience, and innovation, then, are the basic concerns of agroindustrial enterprises. Because of the diversity of raw materials and markets in this sector, agroindustrial processing employs a greater variety of technologies than do most other branches of industry. This gives the investor or planner a wide range of options, but it also heightens the importance of understanding the specific markets and raw materials to be served.

Before a processing technology can be chosen and the appropriate facilities designed around it, the entrepreneur must identify the market for the intended product. As pointed out in Chapter 2, the entrepreneur must have a thorough and precise knowledge of the market because that knowledge forms the basis for product selection and processing decisions. Although the detailed specifications of the raw materials needed will be formulated at a later stage, one should have a general idea from the outset of the range of raw materials that will be needed and their supply prospects.

It is important to recognize that investment design or analysis is an iterative process and that the work at any given stage may call for a change in the interim decisions made at an earlier stage. Nevertheless, the guiding principle throughout these stages is the market approach, which will orient the design of the processing operations toward the wants of the agroindustry's target market. The combined results of the market and processing analysis will then dictate the specific supplies of raw material to be used and the final design of the raw material production and collection system. Although many investments are planned in the opposite direction—that is, from the agricultural sector to the market—the danger in that approach is that the range of production possibilities usually exceeds the market opportunities. Indeed, many enterprises have failed because they were based on incorrect or inadequate market information.

The task of the designers or analysts of the facility is to determine the best processing system and the best means of bringing that system into operation. The design of this package is organized around the four basic elements of the system: (1) outputs, (2) technology, (3) location, and (4) inputs.

The performance of a processing facility ultimately depends on how these elements are affected by physical, financial, managerial, and socio-
economic factors in the surrounding environment. The remainder of this chapter examines these elements and the factors that affect them.

Specifying the Outputs of the Enterprise

The first step in designing a processing plant is to convert what is known about the intended market and thus the proposed product into design and selection criteria that can be used in the engineering and financial analysis of the processing operation. The products of the enterprise will have to be defined in several dimensions: quality, degree of processing, packaging, and the range or mix of products. Market acceptance and market preference in respect of these dimensions were discussed in Chapter 2. This section focuses on the processing and input aspects of product definition.

Product Quality

Product quality is greatly affected by financial, managerial, and socio-economic factors.

FINANCIAL FACTORS. As mentioned in Chapter 2, quality is achieved at a cost. Such costs must be taken into account when establishing quality standards. Particular attention should be given to fixed and variable costs, raw material cull rates, and the costs of other components besides the primary raw materials.

Fixed and variable cost relationship. Because of the inherent seasonality in most agricultural production, the financial performance of an enterprise will depend on the relationship between fixed investment costs and the costs that fluctuate with throughput (see Chapter 5). From the outset, it is important to recognize that different products require different levels of fixed capital investment. Ultra-high-temperature (UHT) milk production, for example, requires more sophisticated and costly equipment than does pasteurized milk, and the fixed charges that will be attached to each unit of throughput will be proportionately higher. A vital question to ask here is whether the volume of raw material is going to be adequate to sustain operations at the level necessary to overcome this cost disadvantage. There may be other important considerations, such as discounts on surplus raw milk production, that can offset the higher investment cost. Otherwise, access to the "new" market—that is, to customers who do not
have access to pasteurized milk—may be the offsetting factor. Other product lines have similar types of offsetting factors that should be identified at this stage.

Raw material cull rates. Processing and distribution systems can seldom improve the quality of raw material. Higher-quality output requires higher-quality input. To a great extent, this can be influenced agronomically (for details of the factors affecting the quality of raw material, see Chapter 4). However, the inferior raw material will invariably have to be removed—by culling—in the first stages of the processing operation. The two aspects of this quality factor to consider are the impact of culling losses on raw material costs and the possibility of converting culls to another saleable product.

Suppose that we would like to consider supplying the market for individual quick frozen (IQF) raspberries because of the premium offered over solid-pack products. The raw material must be uniform in size and color and at a precise degree of ripeness. The share of harvested berries that meets these standards will depend on the growers' skill, their location in relation to the freezing facility, and the management of the purchasing system, but in any event the enterprise will be lucky if 50 percent of the crop meets the IQF standard. If the balance is simply dumped or not harvested, the enterprise will probably not be able to attract growers or satisfy its own financial performance criteria. To pursue the IQF market, then, most enterprises would have to develop juice, concentrate, or puree lines to convert some of the culls to marketable products.

Similar patterns exist among most other agro-based products. To enter higher-quality markets, the processing enterprise must develop other products to make use of greater proportions of culls and by-products. In fact, this principle has given rise to many product lines, which enable processors to establish greater overall market penetration and consumer recognition.

Other product components. The standard of quality adopted for the finished product will also determine the nature and cost of consumables, other than the primary raw material. Secondary ingredients may need to be of higher quality and cost; packaging materials, whether they are designed to protect the product or appeal to the consumer, will also be more expensive, as will the equipment used in packaging.

Managerial factors. The managerial effort that goes into a processing operation will vary with the level of quality required in the output. If
the output is of higher quality, more effort will be required to maintain input quality and to oversee the more sophisticated processes that are usually needed. Two particularly important functions of management in this respect are control and coordination.

Control. As the intended standard of output quality increases, the quality of various inputs to the process must also be more rigorously controlled through the strict enforcement of testing, selection, and handling procedures. Management must ensure that the facilities and trained personnel are always available to perform these functions. In addition, management may be required to integrate laboratory activities into the industrial process for some high-quality products, or specialized storage and handling systems to preserve the quality of materials used in processing operations.

Coordination. As the following sections will illustrate, the industrial process consists of a number of discrete, but closely related activities. The higher the quality standards, the more critical it will be to coordinate these activities in terms of timing and volume of product flow. Automatic handling systems with precise metering devices may be used in place of manual feeding, but this reduces the flexibility and margin for error among activities. The plant becomes more integrated, with fewer buffers or holding areas in the process to absorb slippage or overflows.

Socioeconomic factors. The industrial process that is selected will depend on the people who manage, operate, and maintain it. Early in the process, prospective entrepreneurs need to make a preliminary assessment of the availability, strengths, and weaknesses of the people who will operate the plant.

The quantity and nature of human inputs required for processing, may also be affected by the other quality factors identified above. Here is a list of questions that should be posed at this stage:

- Are the requisite skills and attributes already available in the prospective labor force; will training be required; and if so, what type of training?
- Are the required skills similar to others that are practiced by the prospective work force (which may therefore indicate that they can be easily learned)?
- Are the conditions in the processing operation similar to those with which prospective workers have demonstrated their compatibility?
• Do national or religious holidays, or other demands such as seasonal farming activities, conflict with peak demands in the proposed processing operation?

When management is considering alternative products for the enterprise, a preliminary review of these factors will enable engineers and financial analysts to focus on the feasibility of different products and processes as they relate to the capacity of human resources likely to be available to the enterprise.

**Degree of Processing**

The appropriate degree of processing will depend on certain physical, financial, managerial, and socioeconomic factors.

**Physical Factors.** The degree of processing is governed in large part by physical factors. For example, the later stages of processing, at least on an industrial scale, are usually complicated and require sophisticated equipment. Furthermore, the quality and efficiency standards are normally high and therefore may impose financial, managerial, or socioeconomic constraints on the enterprise.

Blending is another aspect of processing that puts added pressure on the supply of raw materials. Does the enterprise have access to the range of raw materials needed to achieve the desired blend? Producing consumer packages of tea is a case in point. Teas from a number of countries are usually blended to achieve the desired taste and aroma, and enterprises located outside normal trade patterns may encounter difficulty in obtaining these ingredients at an appropriate cost. Tea bags represent another problem: Unless packaging materials are readily available and affordable, an enterprise that is located a good distance from the packaging suppliers may not be able to process to the final stage.

More types of ingredient, other than the primary raw material, are usually required in the later stages of processing. Are these available to the enterprise with reasonable dependability and at a reasonable cost?

Health and safety standards are usually more comprehensive for finished goods, and more complex as the ingredients and processes increase. Market access can be problematic as a result, particularly if the location of the proposed enterprise is not a traditional source of supply to the pro-
posed market; inspectors can be expected to be more wary of this product than those with which they are familiar.

Finished goods usually require more sophisticated packaging than do intermediate products, in some cases because the product needs to be protected or preserved. Retail packing also can be costly when consumer appeal becomes a high priority.

FINANCIAL FACTORS. The physical factors described above have financial implications; in particular, they can affect investment costs, variable operating costs, value added, comparative advantage, and marketing flexibility.

Investment costs. Increased sophistication in the later stages of processing usually calls for expensive capital equipment. Such equipment represents a fixed cost to the enterprise, and it must operate for a significant part of the accounting period to avoid excessive fixed charges per unit of throughput. This in turn places demands on the raw material supply system that may not be possible to meet, either in terms of delivery schedules or viable storage arrangements.

Variable operating costs. As the degree of processing increases, the ratio of capital to labor usually shifts toward greater capital intensity. Even when this is not the case, the more skilled labor generally required at later stages will push up costs and place constraints on the labor supply. The costs of other variables—from ingredients and packaging materials to energy consumption—may also increase.

Value added. The difference between the cost of ingredients and the ex-factory price of the finished product is the value added through processing. However, the ex-factory price typically accounts for a decreasing share of retail price, as the degree of finish increases and a larger share accrues to the marketing and distribution entities in the product chain. This means that consumer price differentials between stages of processing cannot be used to estimate the marginal cost or benefit of proceeding with the next stage of processing. The market structure for each successive stage of processing the product must be examined independently to ensure an accurate assessment of the share of value added that would accrue to the processor.

Paradoxically, value added may be less than the marginal cost as one moves along the processing chain, and cases of negative value added are not uncommon. The explanation lies in the different market structures present at different stages of processing. For example, there are many
suppliers of dried cocoa beans around the world, and their processes are relatively labor-intensive. The production of cocoa butter and powder, on the other hand, is concentrated in the hands of a few large international companies. The processes involved in producing these commodities are capital-intensive and thus discourage new competition, as does the concentration of marketing after this stage of processing. Add to this the fact that much of the capital invested by these enterprises is almost fully depreciated, and it is easy to see that they are in a position to create or weather price wars to protect their continued prominence in the market. As a result, new processors face the double jeopardy of high unit costs, by virtue of depreciation expenses, and periodically low prices as established suppliers protect their markets.

Value added may be negative even where competition is substantial. For example, the raw vegetable oil industry and oil refineries have tended to develop in different locations and under different ownership. Refineries not only have access to different sources of a single raw material, but they can substitute different oils in their processing and in their marketing. A new refinery dedicated to a single source and type of raw oil could find its finished product selling for less than the cost of its raw oil under certain international market conditions that result from commodity price differences and the raw material flexibility of the other refineries.

It is not realistic, therefore, to use average market price differences among products at different stages of processing as the basis for estimating value added. Historical patterns and trends in consumption and competition among competing commodities and industries will enable analysts to assess the probable fluctuations in value added in the future.

Marketing flexibility. The capital cost that usually goes along with a higher degree of processing forces the enterprise to process at least a large proportion of its throughput to that degree to keep unit costs down. Therefore, it cannot respond to market changes to the same extent as an intermediate processor—for example, by reducing volume if raw material prices rise too sharply, or by simply packaging its intermediate product differently to pursue the institutional market if the retail market weakens.

The specifications of finished products usually depend on the market, whereas those for intermediate goods may be similar among a range of geographic alternatives. The firm that is committed to finished products cannot readily shift its output to a different country if there are detrimental changes in demand or in access conditions in the market for which its output is designed.
Comparative advantage. The entrepreneurial spirit arises from the belief that there is a niche for an enterprise to fill between a particular demand and a particular supply. The entrepreneur must not lose sight of that notion in pursuing product alternatives. Even before reaching the point where technology, location, and inputs can be evaluated in detail, it is important to summarize the factors that appear to constitute the enterprise's main advantages.

For example, an enterprise may have the potential to tap a good quality of primary raw material and to obtain high yields, but to do so it would have to be located in an area that does not offer dependable infrastructure to support sophisticated processing equipment. Access to other ingredients or packaging materials may also be a problem. Another enterprise may have an excellent market opportunity by virtue of a close relationship with a next-stage processor who could, however, oppose independent marketing efforts if the enterprise chose to produce competitive lines of finished goods. Each of these circumstances would suggest that the enterprise limit its degree of processing. On the other hand, if skilled labor and good infrastructure and transport links are strong assets, but raw material supply is limited, it is probably best for an enterprise to pursue a greater degree of processing, through which it can convert these assets into value added for its limited supply of raw material.

Managerial factors. The physical and financial factors identified above have managerial implications for the processing enterprise. The greater the degree of processing, the more complex and sophisticated is the role played by management and the less tolerance there is for variation in output standards.

As the degree of processing increases, there will be more stages in the operation to coordinate. The stages also become more interdependent with respect to material and energy flows in the plant. In most cases, a larger labor force will be required, with a wider range of skills. If other ingredients are added to the production system, different material handling systems will have to be set up. It may be desirable to operate facilities at different locations, and almost certainly it will be necessary to have specialized storage and handling systems at different stages of the operation. Each of these additions places greater demands on managers.
Selecting Packaging

One important consideration in packaging decisions is the role the package plays in user appeal, an issue that is discussed in Chapter 2. Beyond the marketing consideration, each product has minimum packaging requirements that depend on its inherent characteristics, and if the technical quality of packaging is improved, the product should have a longer shelf life. The primary or unit pack is most important to the retailer and end user; the secondary pack, or bulking system, is of greatest concern to brokers and distributors.

Physical factors. The physical characteristics to take into account in basic package design are the state of the product (liquid or solid), particle size, and susceptibility to oxidation, hygroscopic reaction, temperature and light sensitivity, and impact damage. There is little scope for varying the package in these respects unless new packaging materials become available that offer the same containment and protection properties as traditional materials.

Packaging needs also depend on market structure. Each market has its traditional packages and bulking units. For example, canned fruit may be packed in #2 cans, 24 to a cardboard carton. Distributors are equipped to handle certain packs; warehouse layout, equipment and shelf sizes are all related to preferred sizes, and if a shipper tries to introduce different units, the proposed change may be too much of a nuisance to be adopted or may create extra handling costs. Also, retailers and end users are familiar with certain sizes of product, and changes at their end may create display and pricing problems, and make comparison shopping difficult.

Within these limits of custom, a particular marketing system may dictate special packaging needs. For example, goods that are exported as general cargo are more subject to damage and theft than those shipped by container. In domestic marketing, a parallel exists between full vehicle shipments and smaller quantities shipped by common carrier. The transport equipment and roads to be used may also necessitate greater protection against physical damage than is required by competitors served by a more sophisticated infrastructure.

Packaging quality, as already mentioned, affects shelf life. The length of time the product remains in the marketing channel will dictate minimum standards in this respect. But the enterprise will be making some discretionary decisions regarding the shelf life of its products as well, and
these must be taken into account in designing its packaging. For example, the shelf life of certain produce items could be extended by going from cellophane bags filled under atmospheric conditions to vacuum-packed units. To stabilize produce that is subject to bruising, the enterprise could shift from bags to shrink-wrapped trays.

If the enterprise is proposing to introduce a new product or enter a new market, it may be in a position to set the packaging norm itself, in which case size should be determined on the basis of normal use patterns—how much is used at a time—and the perishability of the product once the package has been opened. For industrial products, the size of pack should be related to normal inventory management practices, which are concerned with factors such as order and delivery times and utilization rates.

Labeling. Labels convey factual information, and they also induce an emotional response through the words, graphics, and colors used. This latter function serves to heighten consumer appeal in retailing. Whatever the market, certain information must be included on the unit package and the secondary package.

The labels used in retail markets can be classified into three types: national, proprietary, or generic. The materials used, design cost, and quality control all increase as one moves from generic labeling through most proprietary brands to national brands.

Financial factors. The financial concerns in packaging are the costs of the material, equipment, and skill, along with capacity and value added.

Material cost. Fresh produce moves to markets around the world packed in everything from straw to woven styrofoam sleeves, from jute or sisal bags to interlocking polyvinyl chloride crates. These materials differ not only in their production costs, but also in their shipping costs from the point of production to the packing plant. To make sound judgments on packaging materials, the engineers and financial analysts need to know the delivered costs of alternative packing materials.

It may seem more cost-effective to develop alternative forms of local materials than to import packaging from established sources to meet the needs of a demanding market. But this represents a risk for buyer acceptance. It is normally best to pay the added cost of distant materials, or to consider using a different market or form for the proposed product, in which locally available packing materials will be more acceptable.
A vital question to ask here is what degree of processing is acceptable in the packaging material to be purchased? Cans are a classic example. Fully manufactured, cans occupy a large space in relation to their weight, and the costs of transporting them may be prohibitive. In addition, plating, seams, and joints must meet high standards of tolerance, for poor quality can pose a serious threat to the product. All these factors must be weighed in determining the best state in which to purchase cans. In many cases, flattened cans are preferable because they help reduce shipping volume. The enterprise will only need to have reshaping equipment and sealing facilities for the filled cans.

Packaging items for which cost and quality are a particular concern are cans, the lacquers and welding or soldering materials used to line and assemble cans, plastic laminates, foil laminates, lithographed labels, and label adhesives. For product lines that require heat treatment to stabilize quality, aseptic packaging may be an attractive alternative to traditional canning. However, some of these processes are still proprietary, and a premium is charged for the packing materials as well as the royalties on equipment.

In recent years, can design and materials have changed greatly. The canner now has a choice of several packaging systems. Although the preferred technology depends on the nature of the material to be canned, the alternatives now include traditional soldered-seam as well as welded tin-plated cans; nickel-plated, aluminum, and plastic cans; and extruded and rolled cans. The competition among these alternatives is still strong, and analysts need to investigate trends in their own product lines before investing in equipment and material for the long term.

Equipment cost. In many parts of the world, packaging has not yet been mechanized. It is still possible to see lint being manually loaded into bale presses in some cotton-producing countries, and to see it tramped by foot before a final mechanical pressing. However, such a process does not produce uniform bales, and even with a product as stable as cotton lint, quality may suffer if dirt is introduced during the tramping. Some food-canning enterprises still fill glass jars manually from pitchers drawn from boiling vats. Reinfection from ambient sources, as well as poor seals from over- or underfilling, is often a problem here. In contrast, automated filling lines avoid human contact with the product, maintain a constant temperature, and place precise quantities into each container.

The quality benefits of moving to the more capital-intensive packaging method are clear, and in most cases the financial benefit will also be
adequate for the two examples above. At the margin, however, the choice of packaging equipment usually involves difficult qualitative or financial tradeoffs.

To assess the benefits, engineers and financial analysts need market information about product alternatives, particularly about significant price differentials or volume factors. On the cost side, the important factors to test, along with investment cost, are quality differentials, operating capacity, the ancillary equipment needed to link packaging to the processing operations, operating skill and support service requirements, and dependability.

The main concern with respect to the operating capacity of the equipment will be the minimum and maximum volumes for proposed packaging lines, and their relationship with the capacity of the processing plant and expected utilization rate. If there are going to be small differences in the throughput of the processing plant and the operating range of the packing equipment, is it feasible to plan for holding capacity between the two stages to smooth out the overall product flow?

Skill cost. Mechanization also demands greater skills. In the example of cotton baling, those stuffing the bales manually need little skill. In contrast, the operator of the automatic conveyor, tramper, and press units has to coordinate a number of processes, each of which is costly to install and repair, and all of which must work at a reasonable level of capacity to be viable. Press operators will require training and compensation commensurate with these additional skills.

Furthermore, in advanced operations packing needs to be integrated with processing. Packers can no longer work independently; their work depends on what is happening minute by minute elsewhere in the plant, and they must be familiar with other operations to be able to anticipate what adjustments they would have to make in their own activities if conditions upstream change.

Capacity. Although sophisticated packaging often correlates with greater capacity, this is not always the case. The only certainty is that the analyst must relate the capacity of each packaging alternative to the needs of the process and market to be served. Buffers may be possible, in the form of holding facilities in continuous process operations, or different shifts may be scheduled in the case of batch operations.

Value added. Every packaging alternative of an enterprise will have a unique cost structure, and each market will vary in the extent to which it rewards different improvements in packaging. The general guidelines in
this section can be used to identify alternative packaging systems, but they are no substitute for marginal cost-benefit analysis.

Selecting the Product Mix

The market factors to consider in selecting product mix were discussed in Chapter 2. The choice of mix also depends on the process and raw materials involved.

Process-related factors. A fundamental principle to remember in determining product range is that the various ingredients, processes, and packaging operations required for each product must complement one another.

Seasonal complementarity. Fruit and vegetable processing represents a clear example of the product range serving the scheduling needs of the enterprise. It is seldom feasible to process only one species of fruit or vegetable because these crops have a short harvest season. The range of products will depend on the production pattern of the fruits and vegetables grown in the area of the plant. The plant may begin the season with peas and asparagus. Four months later it will still have a source of raw material, but it will now be carrots, onions, and turnips.

Ingredient complementarity. The components that make up a plant's products may each have different sources of supply and require different handling procedures. The more diverse these are, the more difficult it is to manage procurement and receiving functions, and the more costly the storage and integration operations. Hence firms specialize along the lines of complementary ingredients. Coffee, tea, and cocoa have similar handling and storage requirements, and prepared consumer packs of these commodities use similar secondary ingredients—sugar and milk powder. Therefore it is common to see firms processing and trading more than one of these commodities, even if they compete with each other at the end-user level.

Process complementarity. In most cases, the basic process of a plant will represent its most capital-intensive investment and its most demanding skills and management needs. The range of products should be determined with a view to making maximum use of these assets. Poultry-processing plants, for example, are usually species-specific in their design. A plant designed for broiler chickens would probably not do well to go into ducks and turkeys, even if an opportunity arose to expand its market.
through brand loyalty, because this would require substantial new capital investment. A wiser step would be to look into the downstream processing of broilers—different cuts, different packs, oven-ready recipes, and so on, which would increase the demand for products going through the basic line and enable the plant to add value and tap different market segments at the same time.

This complementarity is particularly important if the core process consists of a combination of high capital cost and high energy cost, such as cooking or freezing.

By-products provide innumerable opportunities for product diversification. Continuing with the poultry plant example, the analyst might ask if the volumes processed are high enough to consider producing blood and feather meal. These are valuable feed ingredients that could significantly reduce the cost of raw material in the primary process. One source of by-product that is often overlooked, until environmental issues are recognized, is plant effluent. In the past, plants discarded large quantities of valuable material through drains and smoke stacks, but the installation of concentrators or smoke scrubbers enabled them to capture this material for sale. Distillers have been able to capture gallons of valuable spirits by installing vapor condensers in the ventilation system of aging sheds.

Packaging complementarity. The same considerations apply here as in process complementarity, especially when operations are capital-intensive or the sources of packing material are critical.

RAW MATERIAL FACTORS. The choice of final products ultimately depends on the quality of the raw materials (see Chapter 4). The planner therefore needs some basic knowledge about the quality and production pattern of the raw material in the prospective supply areas.

Quality. Before choosing a final product mix, the analyst needs to consider the present quality of materials available, and then, with the aid of the agronomist and financial analyst, needs to calculate the cost of improving that quality, if necessary, to serve the needs of particular end products. In most cases, the quality required for the primary process or market is the one to stay with; it seldom pays to improve the quality of raw material for a secondary product line. Such improvement should be restricted to selecting from available raw materials for different uses after they reach the plant.

Production pattern. If different products in the proposed line require different raw materials, how do these fit into the farming pattern in the
area served by the proposed plant? Could they fill a gap in farming activity in terms of land, season, and labor use, or would they conflict with more important subsistence or cash crop production?

**Phasing in the Product Line.** The product line is also affected by the relationship between costs and prices, many of which will change over time. Furthermore, an enterprise may be under certain budget or management constraints that permit it to exploit only some of the attractive opportunities at the outset. In either of these circumstances, the enterprise should consider introducing its product line in stages. So in addition to eliminating products that do not make sense under most conditions, the designer should identify the products to be introduced at different stages of development. Such signals at this stage will guide the engineers and financial analysts in their investigation of processes and markets that may have appeal at a later phase of development.

**Selecting Technology**

The technologies available for processing agricultural products range from extensions of traditional artisanal crafts to highly capital-intensive techniques that use sophisticated equipment and control systems. Bear in mind that the technological choices in most processing operations fall into two categories: choices among different kinds of equipment and machinery that accomplish the same process; and choices among processes that produce a similar end product.

Agroindustrial processing does not consist of a single operation, but rather a series of stages, together with support systems. Each component system has its own technical constraints and alternatives. The type of technology to be used must be decided for each stage or system independently, and then examined in the context of the enterprise as a whole. For example, how sugarcane is to be washed before crushing is a separate question from how the sugar mill is to be powered, but the level of steam pressure planned for the mill will influence whether motors in the washing station should be electric or steam-driven.

In its production stages, the typical enterprise will consist of the following physical components: raw material receiving and storage, raw material conditioning, core processes (separation, concentration, mixing, and stabilization), packaging, finished goods storage, and finished goods shipment. At the same time, it will require a variety of support systems:
energy, water, materials handling, waste treatment and disposal, and maintenance and repair.

Most enterprises will also have separate systems to receive, store, and prepare other consumables required in their processes, and at least one by-product subsystem, with its own core processes, packaging, storage, and distribution stages. Administrative and managerial systems and sometimes staff housing will also be needed to ensure that the plant operates efficiently. Managerial issues such as procurement and personnel management are discussed in Chapter 6.

To find the “right” technology—or the best package of capital goods and know-how—for a given enterprise, the analyst must understand the market that the enterprise is to serve and the raw material supplies available to it. Having defined the desired products and established the broad parameters of the raw material supply system, he can identify the other factors that will have some bearing on the processing technology—those connected with the requirements of the product and with the requirements of the process.

During the investigation of technological choices, the analyst should address the following questions:

- What is the probable rate of capacity utilization, and how will this affect production costs?
- What is the relative importance of labor, capital, and other production factors in the cost of each alternative, and how does this compare with the cost of these factors in the planned location?
- How will each alternative technology affect production and marketing flexibility?
- What infrastructure and support service will be required by each alternative technology?
- What are the management implications of each, and are there any socioeconomic considerations that may affect suppliers, workers, or customers?

**Product Specifications and the Choice of Technology**

In general, the relationship between product specification and technology can be described as follows:

The requisite technology will increase in complexity and sophistication in direct proportion to the degree of product specifications with respect to (1) purity, (2) standardization, (3) stability, and (4) degree of processing.
Vegetable oils illustrate this pattern. Most vegetable oils can be consumed in their unrefined state, after simple mechanical pressing of the seed or fruit. But the color and aroma of raw oils mask other food ingredients, and more sophisticated markets demand oils that do not dominate the sensory characteristics of food preparations. Simple refining, consisting of filtration and water removal, produces a product that has more acceptable cooking and shelf-life characteristics, but heat must be added at a fairly specific temperature, and a filtration process must be introduced. Today, however, most markets, other than those in isolated rural areas, demand oil that has been fully refined, through bleaching, deodorizing, and the removal of free fatty acids to prolong shelf life. These processes cannot be accomplished without precise control of the temperature and material flow and the use of caustic soda and bleaching and deodorizing compounds that must be thoroughly separated from the refined oil in additional stages of processing.

Milk is another example in which the process is dictated by the end product. Conventional pasteurization of good-quality raw milk reduces bacteria to an adequate level to permit subsequent distribution and sale through a cold chain over a period of up to seven days. Although milk can be boiled to destroy the bacteria, as it was in the nineteenth century, this changes its flavor and texture. Modern dairies use a continuous-flow process in which the milk is subjected to a higher temperature for a shorter period of time (HTST). This results in a greater degree of sterilization without the off-flavors of boiling but is more capital-intensive and requires greater process control. If the quality of cold storage is unpredictable or shelf life must be extended, the only choice is some variation of (UHT) processing, with the attendant increases in investment cost and process control requirements. Producers will also have to invest in aseptic packaging if they wish to reap the full benefits of the process.

*Process Factors in the Choice of Technology*

Once the product has been identified, the range of technological choices narrows down. Now it is time to determine the efficiency and quality control needed at each stage of its production and to select the technology that will give the desired results.
The design of the receiving facility must take into account the volume, form, and quality of raw material that is to be received. Each factor has technological implications.

**Volume of raw material.** Because of the seasonality of much agricultural production, the raw material is often delivered to the processing plant in a peak period of a few days or weeks. Receiving and storage capacity must exceed plant capacity if processing is to be extended beyond this short period. In view of the perishability of the material, the receiving and storage system should act as a buffer between the highly cyclical production and the fixed costs of processing.

To achieve this objective, it may be necessary to mechanize some or all of the following steps: unloading, weighing, grading, separation and standardization of qualities, and storage. The analyst should also examine the feasibility of reducing peak deliveries through advanced scheduling. Although advances or delays of more than a few hours may not be possible for some perishables such as peas or berries, installing lighting in the receiving area and scheduling 24-hour deliveries, or staggering planting and harvesting times among groups of producers can smooth out deliveries and avoid the cost of investing in larger facilities. In practice, most facilities that process highly perishable raw material work on a 24-hour basis during the harvest period.

**Form of deliveries.** The unit volumes of delivery and the manner in which they are packed affect the cost of receiving and handling. Headloads, sacks, or other small deliveries cost more and take more time to
process than truckloads. Raw materials in sacks or boxes take more time to handle than bulk deliveries. The production pattern in the area served by the plant will determine the ease with which it can move to larger delivery units, as will the payment system, the growers’ need to identify their individual products, and the susceptibility of the material to physical damage or other types of deterioration. Within these constraints, however, planners should try to make individual deliveries as large as practical. This will normally require capital-intensive technologies, and the optimum choice will depend on the relative costs of capital and labor.

Quality of deliveries. Within the limits of acceptable quality established for the raw material, two factors will influence the design of receiving and storage systems: the characteristics used to define the quality of the raw material and the range or uniformity of quality.

If quality can be judged by sight, simple inspection facilities will suffice for this function. However, if the enterprise has to measure moisture content, chemical composition, or the level of small particles or foreign matter in the material, it will need sampling equipment and laboratory facilities for this purpose. If such tests are necessary to determine payment, or to make decisions on storage and handling, they will increase the receiving time as well as the intermediate holding space required before the incoming raw material can be integrated into the plant’s stores. Therefore, technological alternatives that accelerate the testing process are likely to be advantageous.

The number of grades to be handled will also affect receiving and storage operations. Each grade must be handled separately at the receiving end of the plant, with a proportionate increase in the replications of holding, conveying, and storage units. If the plant is going to accept low grades of raw material, it may have to install cleaning and drying equipment to reduce foreign matter and moisture content to the limits required for safe storage. The testing process itself is also complicated by the range of grades. Technological choices here should focus on using the same capital equipment for different grades—for example, conveyors with automatic diversion systems—and portable technology so that preliminary grading can be accomplished before deliveries are received, so as to reduce the mix of grades arriving at the plant in any one delivery.

If the quality of the raw material is related to the yield of the desired component (e.g., sucrose content in sugarcane) and is not a factor in determining the process or product to which the material will be committed, then different qualities can be mixed after receipt and testing. This
reduces the replications of storage facilities required, permits larger storage units to be used, and simplifies scheduling and the handling system between storage and processing. On the other hand, rice that varies in size and shape and contains a high degree of moisture or foreign matter must be subjected to additional processes of precleaning and standardization before it can enter the de-hullers. It must therefore be stored separately from uniform, dry paddy.

RAW MATERIAL CONDITIONING. Before the processing phase begins, further cleaning is often required to remove dirt that would affect either the performance and life of the processing equipment or the quality of the final product. The cleaning equipment used here must meet higher performance specifications than the precleaning equipment used prior to storage and is correspondingly more capital-intensive.

Some older plants do not separate precleaning and cleaning functions in this way. As a result, they have less overall capacity, and the cleaning is not as thorough because of the volume and diversity of material to be removed. When one is planning the rehabilitation of older plants, this is one of the areas in which new investment can produce significant financial benefits.

The process to be performed also dictates conditioning operations, which can be divided into four types: mechanical preparation, temperature adjustment, moisture adjustment, and the addition or removal of biological or chemical agents.

Mechanical preparation. The uniformity with which desired changes take place during processing depends on the shape, size, and composition of the raw material entering the process. In some cases, such as oilseed processing, it may be necessary to remove a portion of the natural material and to break up the remaining components. Many oilseeds are therefore decorticated, and virtually all are crushed, rolled, or broken into uniform particles. Other raw materials may be exposed to high-speed brushes or caustic baths to remove outer layers of material or may be cut into uniform pieces.

Temperature adjustment. Many processes are temperature-sensitive. For example, oil is released more readily from the cell structure of oilseed at higher temperatures. In other cases, lowering the temperature stabilizes certain components, such as fat, and so makes it easier to separate them. Temperature adjustment is also used in combination with water and ventilation to adjust moisture content.
Moisture adjustment. Water is a medium that facilitates the blending of many raw materials and may also form an emulsion from which desired components can be separated. The desired moisture level within the raw material, or the presence of free water, may need to be established before processing begins. This is typically the case for raw materials that can be stored at low moisture levels, but must be brought back to higher levels for processing. For example, water must be added to grain to promote germination in brewing operations and in the production of soy sauce. It is also often necessary to increase the moisture content of grain prior to milling to reduce breakage if whole grain is desired, as in the case of rice.

Addition or removal of agents. Chemical agents may need to be introduced before processing can begin. Sprays, soaking tanks, or rotating drums are used for this purpose and can be installed independently from processing equipment to facilitate scheduling. For example, enzymes may be introduced to break down nonhide materials in hides and skins before tanning, or agents that have been introduced to ensure the safe storage of raw materials may have to be removed before processing. Salt-cured hides and skins must be soaked for 24 hours or longer to remove the salt before other processing steps can begin.

Core Processes

Separation. The first core process in most agroindustrial enterprises consists of breaking up the raw material into its various components. The objective is to separate the desired components from the others they are combined with in nature. By the time the raw material enters this stage, particle size and moisture content should be fairly uniform and any facilitating agents should have had sufficient time to react.

In almost all cases, the first step of this process entails a physical action such as crushing, rolling, shearing, or abrasion. Separation then occurs as a result of one or more of the physical or chemical properties of the components of the material. The most common of these, together with the range of separation technologies, are summarized below.

Location. Components may be isolated simply by virtue of the sequence in which they separate from the material. For example, linters are pulled away from the outside of cottonseed before the seed is subjected to any other action. Separation occurs through abrasion, aided by a system of ducts and conveyors.
Texture. It may also be possible to separate components by taking advantage of their different textures, as in the case of cottonseed and linters. Similarly, muscle tissue and fat can be removed from hides and skins on the basis of their texture, particularly after enzyme treatment. The thoroughness required in separation will determine the time and capital cost to be spent on this process per unit of throughput, and the design of the abrasion or cutting equipment.

Size or shape. Some components naturally break up into particles of different shape or size. The hull or “parchment” and the bean are good examples in the production of green coffee, as are the hull and the kernel in the milling of most cereals. Screens are the most common devices used for such separation, and they range from vibrating inclined units to oscillating units or revolving drum screens mounted on an inclined axis near the horizontal plane, with the slope depending on the flow characteristics of the material. Gates are located at different positions along or around the screens to carry off the different fractions. The performance of these units depends on the total area the material must pass over, the definition of spaces in the surface, and the speed with which the material passes over the classifier. The choice of technology should be based on volume requirements, the degree of difference among fractions to be separated, and the tolerances for the degree of separation of fractions.

Density. Components with different densities can be separated by means of vibration, centrifugal force, aspiration, or flotation. The medium used may be air or liquid. In many cases this will depend on subsequent stages, but bear in mind that there is an energy and equipment cost to removing the liquid from the material at a later stage. Vibration separators tend to be slower than other types; centrifuges are the most capital-intensive; aspirators are limited in the weight and size of particles they can handle, and flotation separation requires space for agitation and settling, as well as considerable plumbing and sheet metal work. If a liquid agent other than water is used, heat, vacuum, and condensation facilities will also be required so that the agent can be recycled.

State. At times, components occur in different states. For example, sucrose occurs in liquid form in sugarcane and can be mechanically expelled from the bagasse. In other processes, such as rendering, the addition of heat will amplify the difference between states and permit separation. (In this case, density differences are also used to isolate the oil and water fractions of the liquid.) Volatility is another property that can be used to promote separation. For example, the hexane used to extract
oil from oilseeds can be vaporized, and thus separated from the oil, by the application of heat and vacuum. The choice of technology depends on the marginal benefits and costs of heat and pressure control and the number of cycles the material must pass through.

**Color.** If the particles of material are relatively small—say, the size of coffee beans or grain—electronic sorters can be used to remove unwanted particles on the basis of their color. This type of equipment is very expensive and should only be considered where the required standards are high and the marginal returns to reaching a particular standard are significant.

**Solubility.** If the component to be removed is soluble in a particular medium, solvent extraction can be more effective than physical means of extraction. Petrochemical solvents have a broader application than water because their solvent characteristics can be specified. They are most commonly applied in removing oil components such as vegetable oils from crushed or rolled oilseed cake. The solvent can be passed through the material in several ways: percolation tanks, counterflow tanks, or vessels with agitators. Capital costs and throughput rates vary, and the absorption rates of the solvent and material combination in use will determine the degree of choice available to the designer.

The separation process also produces waste and by-product fractions of the raw material. Those responsible for the design of the separation stage need to know what these components are and how they are to be disposed of so that a method can be devised to remove them from the main production line as efficiently as possible. To move these products away from the primary processing line and stabilize them for subsequent treatment, the enterprise will need a collection and conveying system and tanks, bins, or flat storage, depending on the physical characteristics of the material.

For the most part, the cost of isolation is insignificant in comparison with overall plant cost, except in the case of dry processes that create a significant amount of dust. This is often a combustible mixture, and settling chambers, cyclones, or even ion exchangers may have to be installed to remove such particles from the air. The energy and capital cost involved may be significant. The risk of combustion, as well as the value of the reclaimed material and environmental regulations concerning the particular material, should be the guides used to determine how thorough the removal process needs to be.
CONCENTRATION. In principle, concentration is yet another means of separating components that occur naturally in a liquid form. The most common examples are fruit juices and sucrose, in which the flavor, aroma, and nutrient elements occur in a water medium. The water adds nothing to the desired characteristics of the material, while creating transport and handling problems. In other cases—such as essential oils—the desired elements occur in solution or colloidal suspension with other elements that detract from the desired qualities of the component that is to be isolated. Several processes can be used to accomplish concentration: heat can be applied, the material can be subjected to a partial vacuum, or it can be accelerated to speeds at which different components will behave differently. Heat and a vacuum are generally used in combination.

The application of heat. With the application of heat, particle or molecular movement accelerates; this occurs at different rates for different substances. In most concentration processes, the objective is to raise the temperature of the material to a level at which one or more of its elements will become sufficiently volatile to be drawn off as a gas from the other components, will remain in a liquid state. If the enterprise is mainly interested in the liquid fraction, this operation alone effects the concentration; if the objective is to isolate the gaseous fraction, plant operators must subsequently lower its temperature, in a different vessel, to a point where it condenses and returns to the liquid state. This process of first adding heat to create and separate liquid and gaseous fractions, and subsequently cooling the volatile fraction, is known as distillation.

A classic example of simple concentration by heating can be found in the production of noncentrifugal sugars. Known in India as gur, in Africa as jaggery, and in Latin America as panela, this product is made by heating cane juice in open pans until it reaches a level of concentration that will solidify when the material is cooled to ambient temperature. This same technique is used to convert sap from maple trees in the northeastern region of North America into maple syrup and sugar. Reduced by a ratio of 8:1, the cooled concentrate remains liquid, as maple syrup. Further reduced by a ratio of about 2:1, the product cools into a cake known as maple sugar. Other examples of this process include the sun drying of sea water to produce salt, and the drying of rubber latex to produce latex sheet. The term “smoked sheet latex” derives from the fact that drying has traditionally been accelerated by suspending the material over open fires.
This form of processing removes only water, and perhaps small amounts of aromatic material, with the result that the finished product contains all of the nonvolatile elements of the raw material component. For example, the sugar that concentrates out in the open pan method has chemical impurities that may add to or detract from consumer appeal, depending on the particular market. Further refining must be performed if purity is desired.

Most liquid foods can be used in their natural degree of concentration, but if the water content is reduced, this either improves handling or results in a different product. The concentration of fruit juice reduces weight and volume for a given quantity of flavor, aroma, or texture elements. Further reduction results in pastes or purees that can be used as ingredients in final products without diluting the flavor, aroma, or physical characteristics of the other ingredients. Tomato paste is an example of a product concentrated for this latter purpose, as are tropical fruit purees used in bakery, dairy, and confectionery products.

Note that if a paste or puree is to be produced, the initial separation process should not remove all of the cellular component of the fruit. Peel, cores, stems, and seeds will detract from the final product, but pulp from the fleshy portions of the fruit will give the necessary bulk and stability to the product. Specifications in this respect depend on the market and product.

The technical alternatives available to achieve concentration by the application of heat vary mainly with respect to the energy source, the heating medium, and if the heat can be applied directly to the material or must be applied indirectly through a transfer mechanism. Air and water are the heating media that are used in all but very specialized applications. However, air cannot carry significant quantities of heat in temperature ranges that will not damage the raw material, and very large volumes are therefore required to remove large quantities of water. Where direct heat application is appropriate, air must be used because most of it passes through the material and separates of its own accord. Otherwise, air has given way to water, in liquid or steam form, in most modern processes.

The current trend in agroindustrial processing is to use water at very high temperatures and pressures as the heating medium. Live steam, (i.e., steam under pressure) is the most efficient medium because of the heat it can carry and transmit per unit of volume, the high temperatures to which it can be heated, and the fact that heat transfer rates increase with
the temperature differential between the medium and the raw material. There are significant drawbacks to using live steam technology, however, related to capital cost and economies of scale.

Direct versus indirect heating. Direct heating with water is not a viable alternative in concentration processes, but the direct application of hot air is. Sun drying or suspension of the material over an open fire are traditional examples of this technology. This technique has its limitations in terms of quality control. It is very difficult to prevent the material from being adulterated by smoke or dust in these operations. It is also difficult to control temperature, with the result that the material may dry unevenly or may be damaged by heat. Today direct heat is only applied in the slow drying of materials in enclosed chambers, as in the production of starch, although even here, energy is lost because spent air is too high in moisture to be recycled, yet it contains heat that was created at a cost in energy.

Consequently, the trend in all industries is toward indirect heating, using water or steam, and heat exchangers in the form of coils or plates over which the material is passed, or jackets around vessels or pipes through which the material is pumped. The rate at which heating occurs depends on the length of time the material is exposed to the exchanger (i.e., the rate of throughput), the ratio of the exchange surface to the volume of material, and the temperature differential between the heating medium and the material. Because of the importance of this temperature differential, heating should usually take place in stages. Energy efficiency dictates that the spent medium from the last stage should be used to perform the heating in earlier stages, where the temperature need not be as high to maintain the same differential.

Application of pressure differentials. Volatility is inversely related to pressure. For a given temperature, the conversion of a material from the liquid to the gaseous state can be accelerated by reducing the pressure of the material. This results in energy savings, and precise pressure control can be used to isolate different elements of a material that have different levels of volatility. Pressure control technology is usually capital-intensive, because the material must be handled in airtight, pressure-resistant vessels, and because operations must be controlled with precision.

In most modern agroindustrial processes, concentration is effected through a combination of heat and pressure techniques. The cost considerations identified above, rather than the adverse effects on the raw material, will normally be the overriding factors in determining the choice of
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combination of temperature and pressure for a particular process. However, many raw materials can be damaged by the application of excessive heat. Inadvertent cooking may gelatinize proteins, caramelize sugars, or otherwise change the nature of the raw material in a manner that will reduce its quality or affect subsequent operations. In such cases, greater pressure differentials and lower temperatures will be required.

The efficiency of concentration efforts can be increased by passing the raw material through stages that use different combinations of heat and vacuum. These "multiple effect" facilities operate on the principle that heat is more costly to generate than a partial vacuum. In the first stage, the raw material is heated to the temperature required for the desired volatility at or near ambient pressure. As a portion of the liquid—water in almost all cases—vaporizes and is drawn off, the material cools, but rather than being subject to continuous heating, it is pumped to another chamber that is maintained at a lower pressure, and vaporization continues to occur at an efficient rate.

Since evaporation occurs at lower temperatures under vacuum, this process also preserves flavor and other quality factors in products that are sensitive to heat. As many as four or five stages or "effects" can be installed in series, depending on the material and the initial temperature, so that almost all of the artificially induced heat can be used in vaporization. This technology is one of the most important innovations in sugar production technology in recent years and is now widely applied in other concentration processes.

Freeze-drying is another form of concentration using pressure differential. In many cases, when a product is to be reconstituted from a dry form by the customer by adding water, it is desirable to maintain a porous crystal structure in the concentrate. This is achieved by freezing the full-strength product, rather than heating it, and then removing water by subjecting the solid material to a partial vacuum. The water is drawn off as a gas without going through a liquid stage (sublimation).

Concentration by acceleration. If the material that is to be concentrated occurs in colloidal suspension or consists of a liquid and mixture of fine particles that normally would take a long time to settle out, the centrifuge may be an appropriate technological choice. It may be necessary to heat the mixture to reduce its viscosity and the adhesion of its elements, which will differ in specific gravity and will therefore respond at different rates to centrifugal force. The shape of the spinning vessel can then be designed to guide heavier elements to different ports around the perime-
ter, from which they can be drawn off. An example of this technology that has been used for many years is the cream separator in the dairy industry. Sugar crystals are also separated from cooled syrup by centrifuge.

Some dry materials can be separated by ejecting the mixture into air and permitting fractions to settle out at different rates in relation to their size or density. Separation occurs because the particles differ in their resistance to air rather than specific gravity per se. The stock is blown into a chamber, and deceleration occurs in relation to particle size, so that different fractions of the mixture will fall to different points at the bottom of the chamber. Fractions can then be drawn off separately, or recombined in a desired order by placing ducts or moving belts at the bottom of the settling chamber. This technology is used in the wood industry to produce particle board; small particles are concentrated at the surface of the product to provide a fine surface, while larger wood particles fall to the middle of the range and provide the strength of the product.

Mixing. Most mixing operations are performed with mechanical agitators such as paddles or rotating drums with stationary bats. Some liquid mixtures can be ejected through high-pressure nozzles to achieve the same results. Others can be mixed to some degree through aeration, but this is a slower, less even technique and is usually used in combination with mechanical agitation when more time is needed to allow a chemical process to occur in the material during mixing. Mixing is used to increase product uniformity primarily in liquids, but particle size may also be a problem in certain solids such as mixed feeds. Similar mixing devices are used for solids, but paradoxically, they tend to separate again more quickly than liquids, and must be quickly stabilized in a process such as pelletizing (see below).

There are two basic types of mixing operation: those that evenly disperse the various elements occurring in concentrated form in the raw material, and those that incorporate other ingredients into a mixture with the raw material.

1. The classic example of a mixing process that produces even distribution is homogenization in the dairy industry. Milk consists of 94-97 percent water and dissolved solids. The remainder is butterfat that occurs in globules of various sizes suspended in the water solution. Centrifugal separation is used to remove the fat, which is used in other products, and to establish the desired level of sus-
pended fat for the milk product to be marketed. However, the remaining fat globules tend to rise to the surface of the milk, unless they are reduced in size. Homogenization is the process used to break these globules down to a size that will remain in suspension in the milk. It is usually achieved by forcing the milk mixture through a high pressure nozzle.

2. Most mixing operations consist of blending other ingredients together with the raw material. Here the choice of equipment depends on the precision with which ingredients are to be measured, the rates of dispersion of minor ingredients, and whether the blending initiates a chemical process that in turn must be controlled and arrested. If one of the additives is an agent that must subsequently be removed from the product, an independent separation process will have to be introduced, using one of the techniques described in the preceding section. In refining vegetable oil, for example, caustic soda is added to the oil to remove free fatty acids. The resulting soap stock is heavier than the oil and settles to the bottom of the tank or onto plates from which it can be ducted away for final separation from the residual oil.

Measuring ingredients. Ingredients can be measured and added manually if precision is not critical, or if the mixing process is slow enough to permit the ingredient to be added progressively until the desired level is achieved. These conditions are normally associated with batch processes and traditional products that have evolved from crafts. It is not uncommon even in modern dairy operations to add retsin manually to milk in order to produce cheese. Similarly, in the preparation of animal feeds or the small-scale canning of fruit or vegetable mixes, the tolerance for variation in the proportions of ingredients is sufficient to permit them to be added manually.

As the size and speed of operations increase, most enterprises move from batch to continuous-flow operations and ingredients are measured and added automatically, by trip scale or electronic metering devices. This technique is used to add Vitamin A to fluid milk, for example, sulphur and other stabilizing agents to rubber, and sugar to water in the preparation of syrup in large fruit canneries.

Agents that promote a chemical reaction in the raw material require careful monitoring. Such reactions often create changes in temperature, viscosity, or acidity, conditions that are themselves critical to the reaction
process, but that can be either self-defeating or can damage the raw material if uncontrolled. In processes such as fermentation, the mixing equipment must be designed so that the process can be monitored precisely and the critical condition can be controlled during the mixing and reaction phases. Temperature control is the most common performance factor in this respect, and whether with heating or cooling coils in the liquid, or a jacket surrounding the vessel, it must be possible to adjust the rate of heat transfer to compensate for changes that occur at different stages of the chemical process, or as a result of inaccurate control during formulation.

The time it takes to complete a process is another important variable in mixing operations. If mixing is a matter of dispersing elements evenly in the material, the length of time this takes will be of concern, not only because it may reduce efficiency, but also because particles tend to break down in mixing, and this can be detrimental to product quality. For example, in feed formulation or dry food mixes, fine particles and dust that result from impact or abrasion during mixing will tend to settle out during later processing, or reduce palatability or buyer appeal.

The mixing period is more critical when chemical reactions occur. For most agroindustrial products, processes such as digestion or fermentation must be arrested before they run their complete course; this is done by stopping the mixing process at a precise stage. The critical factor that facilitated the process, such as temperature, must be changed, or a neutralizing agent added.

**Stabilization.** When the product has been blended, or the reaction process has been completed, it must be stabilized. This is the preservation stage, in which deterioration must be slowed down to a rate that is consistent with the shelf life and quality standards required for the intended market. Two forms of stabilization are accomplished during mixing; curing or pickling, and fermentation. Packaging is an important part of stabilization that is discussed in a later section. The other forms of stabilization are drying, aggregation, cooling and freezing, heat sterilization, and irradiation.

**Drying with heat.** The bacteria, mould, and enzymes responsible for most spoilage require at least some moisture to become active. If their presence in a dormant state does not jeopardize product quality, stabilization can be achieved simply by reducing the moisture content until it is below the critical level. That level is maintained by means of the packag-
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ing and storage conditions, as in the case of cereal products, dehydrated vegetables destined for reprocessing, bullion cubes, and milk powder. Rehydration will be required before the product can be consumed or further processed. The suitable application of this technique may be limited by the fact that flavor, color, or texture characteristics are usually altered by drying.

Drying is also used for products that are processed in liquid form but stored and used in solid form. Sugar is a good example, as is the starch of cereals, cassava and legumes—all important products in certain regional and end-use markets.

Sun drying is the most traditional form of desiccation, and it is still practiced in many regions and for many products. Although this form of drying is inexpensive because the energy is free and the facilities are usually simple, it does have several significant drawbacks: the sunlight may not be strong enough or dependable enough to ensure that the product will not deteriorate during the process; the product may be adulterated by windborne or surface impurities; the rate of drying is difficult to control, with the result that over- and underdrying can occur in the same batch; the rate of drying may be too slow to prevent fermentation or mould formation; and if the product is re-wetted by rain during the drying process, it will dry unevenly and may deteriorate. Consequently, direct sun drying is generally used only to stabilize the products of small artisanal operations.

However, a variation of this process has become economically viable in many circumstances in recent years: solar energy is collected in absorption units and transferred in the form of heat to air or water, which is then ducted to the material to be dried. The material can be placed in facilities protected from the elements and arranged in bins, on slats, or in heat-exchange chambers to ensure that the heat is distributed evenly. Photoelectric cells can also be used to convert sunlight to electric power to drive ventilating fans or pumps that in turn drive the drying system. The important factors to consider in assessing the appropriateness of this technology are the intensity and distribution of sunlight in relation to production needs, the size and shape of material particles to be dried, the amount of moisture to be removed, and the cost of alternative energy sources.

In modern agroindustrial processes, the fuels used to generate heat range from waste products such as cereal husks or sugarcane bagasse to wood, charcoal, and fossil fuels. The technical factors to consider when
investigating alternative methods are, for the most part, similar to those discussed under product concentration (the medium—air or water—and whether or not the heat is to be applied directly).

The drying process used to stabilize a product differs from the drying used for concentration in one important respect. The finished product in the former case will be a solid; if it begins the process as a liquid, it will tend to dry as a single mass, and mechanical devices will have to be used to promote the formation of crystals or to break the mass into the desired particle size. If crystals are desired, the classic example being sugar, seeding will be necessary at a critical degree of concentration to promote crystal formation; furthermore, when these crystals reach the desired size, they must be separated from the remaining liquid—usually in a centrifuge—to arrest their formation. In the case of starch products, the dried mass is broken in a beater or mill, and screened to ensure that particles are uniform in size after the drying is complete.

The equipment designed for heat drying applies heat either to batches or to a continuous flow of material. Multiple-effect or counterflow technology is used to increase energy efficiency. The choice of equipment should be based on the following criteria:

- The relative cost of energy and the capital investment required for energy-saving equipment
- The precision and uniformity of drying required, which can be more readily controlled in continuous processes
- The relative cost of labor and capital (bear in mind that batch processing is usually more labor-intensive and continuous-flow systems more capital-intensive)
- The rate and temperature at which drying must take place to avoid damage.

The drying system is usually laid out in one of the following ways:

- Open pans. This is a relatively inexpensive process in which evaporation takes place at ambient pressure. It may be suitable if contamination from ambient sources is not a serious constraint, and if space is available. The material can be managed manually or by paddle conveyors.
- Pressure-controlled chambers. These vessels, aligned in a series, permit drying to take place in stages and are suited to multiple-effect, energy-saving technologies. Special mechanical equipment
will be necessary at the later stages to manage the viscous or dry material.

- Column dryers. To save space, and to make use of gravity and convection forces to reduce transfer costs, many plants are using column dryers. These usually contain plates that transfer heat indirectly and are set up so that the heating medium and the material to be dried rotate in the opposite direction and thus keep temperature differentials at the desired level while making maximum use of the available heat. Mechanical devices are required to extract the dried material from the bottom of the column.

Drying with pressure differentials. As in the case of concentration operations, reduced pressure increases volatility at any given temperature and a partial vacuum is therefore often used in combination with heat to reduce the cost and time of drying.

In many cases, extreme and sudden changes in pressure are sufficient to effect instantaneous drying. This is accomplished by ejecting material from high-pressure nozzles into vacuum chambers. Milk powder and soluble coffee are the two most common applications in food processing. Some prior heating may be required to ensure that the temperature drops sufficiently across the pressure difference. The feasibility of this alternative depends on the nature of the material: It must be in liquid form, in order to pass through the nozzles under high pressure; and it should not contain abrasive elements that would accelerate the deterioration of the nozzles. Furthermore, the dried product emerges from the chamber in powder or fine flakes and must therefore be acceptable in that form in the market. It can be reformed to some extent if the product retains enough moisture to act as a binding agent, as explained in the next section.

Aggregation. If a dried product consists of different ingredients made up of different-sized particles, these ingredients will tend to separate during handling and storage. This may affect buyer appeal, palatability, or uniformity for subsequent processing. Such products are usually aggregated into uniform-sized units while they still contain some moisture from the mixing process that can serve as the binding agent. In the case of dry-mixed products such as some animal feeds, or other products with surface characteristics that prevent adhesion with moisture, a binding agent may be required. Molasses serves this purpose in feeds, and in addition plays a nutritional role.
The simplest form of aggregation takes place at ambient pressure. The moist material is fed into the top end of an inclined rotating drum, which resembles the one used in separation operations, except that the surface is not screened. Bats—rigid panels fitted to the inside surface of the drum—may be used to increase the rolling action as the material descends the length of the drum. This relatively slow-speed tumbling brings the particles in contact with each other and aggregation occurs. Forced air or indirect steam heating may be used to complete the drying process in the lower section of the drum. The size of the final aggregate will depend on the tumbling action (which also ensures uniformity in the material as aggregation takes place), adhesion characteristics, the time it takes to complete the process, and the rate of drying. Fertilizer granulation is probably the largest application of this process, but it is used to process food and feed as well, including some compound animal feed products and breakfast cereals.

Aggregation under pressure is a more sophisticated version of the process. Material that is uniformly mixed is injected under very high pressure into dies, which give the final product its characteristic shape and size. The pressure applied during the injection together with heat generated by friction is the basic cause of adhesion, but additional heat and binding agents increase the range of products that can be aggregated in this manner. As the material emerges from the dies, it may simply break off under its own weight into random length pellets, or it may be shorn off to yield uniform pellets. Final cooling and drying will usually follow, using forced air, but, properly prepared, these pellets are a very stable form of product. Moulds may be used to produce briquettes in a variation of this process.

Cooling. The metabolic rates of organisms that attack food products can be reduced by lowering the surrounding temperature. Cooling also slows the metabolic processes of products such as fruits and vegetables that remain alive after harvesting and packing. In this latter case, processors may wish to retard flowering, ripening, or germination, depending on the product. It is particularly important to retard the ripening of fruit, because their flavor and texture change during this process, which in nature culminates with the deterioration of the flesh and release of the seed.

Whether our concern is to prevent infestation or delay the metabolic processes of the raw material itself, it is essential to lower temperature quickly after the raw material has been collected. For example, the bacte-
Bacteria population in milk will multiply more than 100 times in 24 hours at 15 degrees Centigrade, but this slows to less than a doubling in 24 hours at 4 degrees. The cooling of milk should begin on the farm or, if that is not feasible, within three or four hours of milking when it is delivered to the collection station. In this latter case, a low initial bacteria count is critical because of the multiplication that will occur before chilling. The metabolic activity of fresh produce should be slowed quickly after harvest by removing field heat. This step, usually achieved by a cold water dip or spray, can also form part of the cleaning process that occurs as soon as the goods arrive at the packing station. Cooling immediately after harvesting is particularly important for leafy produce such as lettuce and spinach.

The appropriate temperature for stabilizing products will depend on the natural process that needs to be retarded and the product’s susceptibility to damage from cold. These temperatures are very specific and range from zero degrees Centigrade for cabbage to 13-16 degrees for ripe bananas.

The choice of cooling medium and the design of cooling facilities will depend on the quantity of heat to be removed, the shape and size of product units, and the rate at which cooling should take place. In most cases, the medium will be either air or water. Air can be moved across the product by convection or forced by a system of fans and ducts; water can be sprayed over produce, or the produce can be immersed in tanks of cold water. Convection air is usually the slowest means of extracting heat for any given temperature difference, while water immersion tanks work fastest. As the amount of heat to be removed, the desired rate of temperature reduction, or the cross section of the units of produce increase, immersion tanks become the more appropriate technology. Counterflow or staged operations help to reduce energy costs by using spent medium from later stages to initiate cooling at the start of the process.

Freezing. Freezing is simply cooling carried to a further degree, except that in this case the natural metabolic processes of products or infectants are arrested, rather than retarded. As a result, the shelf life of frozen perishables can be many months, compared with days or weeks for chilled goods. However, the energy and investment costs that go into freezing are generally much higher than those for cooling facilities. Moreover, freezing breaks down the cellular structure of the product so that, once thawed, its texture tends to be inferior to that of the unfrozen product.

More types of medium are used in freezing than in cooling. They range from air to brine, invert sugar solutions, and liquid gases (mainly
carbon dioxide and nitrogen). The choice depends on the rate at which freezing is to take place. The faster processes are usually the more costly ones. Air is not usually cooled below -40 degrees Centigrade; brine and sugar solutions are not as cold, but liquids can extract more heat per unit of volume than air can for any given temperature; liquid nitrogen or carbon dioxide, used as a spray, can be as cold as -195 degrees Centigrade.

The temperature to which the material must be reduced after it has reached the frozen state, being also in most cases the temperature at which that material must be stored, varies from one product to another. For example, most fruit and vegetable products can be safely stored at -18 degrees Centigrade; the temperature of meats, on the other hand, should be reduced to -28 to -30 degrees, and sashimi-grade fish should be frozen and held at -40 degrees.

One other factor needs to be considered in choosing the medium and facilities for freezing. The rate at which freezing takes place determines the size of ice crystals that form in the product. Slow freezing produces large crystals that are more damaging to the cellular structure of the material. As a result, products with a fragile natural structure (such as berries) will deteriorate into a shapeless watery mass after thawing if they have been frozen slowly. A high-priced market has developed for enterprises that can control the ripeness of their raw material and freeze it very rapidly. This “individual quick-frozen” product is spread out on trays or screens and then frozen rapidly in blast freezers or sprayed with liquid nitrogen.

In all freezing processes, heat should be removed from the product in a chilling stage before passing to freezing. The freezing medium is much more costly to prepare in terms of energy than the cooling medium, and this staged approach reduces the quantity of heat that the freezing medium must absorb. Another essential design feature in freezing plants is that the cooling medium must be recycled through a condenser in a closed system so that ambient heat is not permitted to waste the energy expended to lower the temperature of the medium.

Freeze-drying. Freeze-drying is a specialized preservation system that is used to create porous aggregated particles of a product that will be stable at normal ambient temperatures. It is primarily applied in the preparation of instant foods, because the open structure of the materials permits them to absorb water rapidly and thus return to a moist, consumable form. This technology is probably most widely used for soluble coffee, dried soup and noodle mixes, and other light-weight meals. The
The underlying principle is sublimation, whereby some substances, in this case water, pass directly from the solid to the gaseous state without going through the liquid stage. The product to be stabilized in this manner is first frozen and then placed in a low-pressure chamber where sublimation occurs; the moist air is drawn off and the dry product, still in the form in which it was frozen, passes out into ambient pressure for sorting and packaging. This process requires a large investment of capital and energy; it is a batch process and is fairly slow. As a result, it is only viable for products that can bear a high processing margin in their retail price.

Heat sterilization. In contrast to drying, cooling, and freezing, the objective of heat sterilization is to kill contaminating organisms, rather than simply to render them dormant. The traditional method—commonly referred to as canning—is to place prepared materials in an airtight container and then heat the package and its contents to a temperature known to be fatal to the infectants, and to keep temperature at that level for a predetermined period of time. Glass containers are still used for this purpose, mainly in artisanal operations or in the home, but the invention of tin-plate cans made it possible to industrialize the process on a large scale.

The effectiveness of canning operations depends on a number of critical factors.

- The preparation of the material to be canned. Even in mixed materials such as prepared foods, the ingredients must absorb heat in the right amount and at the right rate to ensure that all the components have been sterilized.

- The initial level of infectants. The material to be sterilized must enter the container in a relatively clean condition if sterilization is to reduce final infectant populations to levels that will prevent them from acting on the product.

- Uniformity and level of filling. After sterilization, as the container cools, a partial vacuum forms between the top of the material and the seal of the container. Without this vacuum, the seal and the container are ineffective. The vacuum cannot be created unless the correct amount of "head space" is present. Overfilling can also cause material to spill onto the seal and prevent it from closing properly and bonding with the container.

- Uniform cooking characteristics of ingredients. Since all ingredients will be subject to the same temperature and cooking time, they
must not break down at different rates or develop off-flavors at different rates if the final product is to retain consumer appeal. Cutting different materials into different sized pieces, or precooking selected ingredients for different periods before canning can reduce this effect for some mixed products.

- Quality of container. The container must be strong enough to withstand the heat and pressure of the sterilization process and must be made of or coated with a material that is nontoxic and does not flavor or color the contents. Breakage is the most common problem of glass containers, while the quality of plating and seams are critical in cans. The shape of the container and the lid must be uniform to effect a complete seal.

- Temperature-time relationship during sterilization. Although certain minimum temperatures are required to destroy particular infectants, the overall sterilization effect is a function of time and temperature. These elements can be manipulated to improve energy efficiency and throughput, but perhaps a more important consideration is to achieve the desired sterilization without causing heat damage to sensitive ingredients. Higher temperatures for shorter periods normally reduce such damage.

- Cooling. If the products are susceptible to heat damage, the packages must be cooled as quickly as possible after sterilization to arrest the cooking process.

These factors—together with the cost of capital, labor, and energy for the proposed location—are the basic criteria used to choose the appropriate technology in the canning process.

Another important factor to consider, however, is the delivered cost of the containers, which can make up more than 50 percent of the direct cost of fruit and vegetable products (see the discussion of financial factors under “Packaging”).

Technological developments that have taken place in each of the stages of canning are summarized below.

- Product preparation. The trend has been toward less human contact in the separation, cutting, blanching, and blending processes of preparation. This helps increase throughput rates and the uniformity of ingredients, but its most important effect is to reduce the risk of product contamination. This trend is also associated with a shift from batch to continuous-flow operations.
• Filling containers. Automatic fillers have two technological advantages over manual operations: The level of the contents and their temperature as they enter the container can be kept more uniform. As already mentioned, a good seal cannot be achieved unless the contents are at the right level, while the temperature must be at the critical level to ensure that all the ingredients are properly sterilized. The choice between manual and automatic filling will therefore depend on how important these factors are to the particular product and the relative cost and performance of the labor and equipment options. The choice of equipment will depend on its capacity, degree of automation, and whether or not it is flexible enough to handle the different materials and container sizes that may figure in the plant's product line.

• Sealing. This step is automated in all but the most primitive operations. Again, in choosing equipment, the investor will be primarily concerned with its speed and its ability to handle a range of container sizes.

• Sterilization. Boiling water in open vats is the least sophisticated and the least capital-intensive means of sterilization. However, not only is heat lost to the surrounding air in this process, but temperatures cannot be raised above the boiling point of water. Some infectants are not destroyed in this temperature range, and the plant cannot implement temperature-time variations to suit the product. Consequently, most sterilization processes are now performed in high-pressure vessels, or retorts. The retorts are heated with steam, rather than water, because of its greater efficiency and higher temperature range. Mechanical devices can be used to load and unload the retorts and thus increase the rate at which these operations can be performed, and the share of available time during which the process can be in operation. If operations are rotated among a number of retorts, steam can be applied continuously by directing it to filled chambers while others are being emptied or charged; this layout also keeps the product moving from the sealing stage and into the cooling and packing areas of the plant at a smooth and steady pace.

• Cooling. Depending on the rate at which cooling must take place for any given product, cans or bottles may simply be spread out for air cooling, with space and table area being the only capital requirements. In most modern operations, however, this is not an
efficient design, and water cooling is necessary. Rapid cooling also arrests cooking action in the product. The quickest method of cooling is to immerse the product in tanks of cooled water. In this system, all heat acquired by the water will normally have to be removed in a refrigeration system if the water is to be reused, and this carries an energy and capital equipment cost. Spray or cascade coolers permit some of this heat to be dissipated in ambient air, thus reducing the energy cost of water cooling.

Aseptic packaging. This is a specialized form of heat sterilization in which the heat is applied before packaging takes place. The greatest advantages of this method are the greater uniformity and control possible in the sterilization process and the wider range of packaging materials that can be used because they are not subject to the stress of pressure and heat of the sterilization process. If this method is to be effective, however, the product must be maintained in an aseptic environment between sterilization and packaging, and the packaging material must also be sterile.

Products that undergo aseptic packaging must be treated in a fluid form because the entire process takes place in pressurized pipes and chambers through which the material is driven by pumps. Viscosity can range from that of full-strength apple juice to purees with some fiber content, but higher pressure is required to drive the latter through the system. Abrasion will also increase the replacement cost for nozzles, impellers, and other components for handling materials that contain fiber or other suspended solids. Another feature of this system is that the material is heated in a very fine stream so that temperature rises rapidly and uniformly across the material. The temperature can then be lowered with equal speed and uniformity. Thus the system provides precise control over the temperature-time combination and keeps heat damage to fragile products to a minimum.

This is obviously a capital-intensive technology. It is also still proprietary in most cases, and the user must pay royalties and buy consumables such as packages from sources specified by the equipment supplier. This is not simply a monopoly charge; it is the manufacturer’s way of ensuring quality control over a critical aspect of the process.

Irradiation. Irradiation was used as early as the 1950s to prevent germination in stored potatoes. However, research and technology were not
Serious quality problems arose in an aseptic packaging plant installed in an Asian country to process fruit juices in the mid-1980s. Modern equipment was used in the operation and the packaging materials were supplied from a reputable source. Nevertheless, the shelf life of the new product was unacceptable; it began deteriorating in several weeks rather than remaining salable for three months, as guaranteed by the equipment manufacturer.

The owners of the facility filed a complaint against the equipment manufacturer for what appeared to be a breach of warrantee. The problem turned out to be something else, however.

As the foil and paper laminate packages were removed from their shipping boxes and placed on the conveyor to be fed to the filling machines, a jet of air was provided to open the top end of the container. But not enough air pressure was being fed to the unit to do the job, and operators were rounding out the opening of some of the containers with their hands. As a result, infectants were introduced, and they multiplied quickly once the container was filled.

advanced enough to indicate the proper dosage or the equipment needed to maintain precise control, and the technology was not widely applied as a result. In recent years, in part as an offshoot of medical research, these constraints have been largely overcome and there is renewed interest in this process, particularly for the control of insects and diseases during the postharvest period.

The process consists of exposing a measured quantity of product to either gamma or electron radiation of a controlled intensity for a predetermined period of time. The processing facility consists of a small, shielded irradiation chamber along with either electron-generating equipment or cobalt management facilities, and a system of conveyors to deliver the packaged product to the chamber and remove it for assembly and shipment. The industrial engineering aspects of plant design have been adapted from the medical supply industry, where this technology is widely used in the sterilization of hospital and over-the-counter products.
No radioactivity remains in the treated food, and research indicates there is no evidence that the by-products are different from those of other forms of preservation, such as cooking. The radiation, measured in Curies, has different effects at different levels. Lower levels sterilize and kill insects, bacteria, and other forms of infestation that either damage the product before sale or render it unacceptable in the intended market. At higher levels, radiation arrests maturation in fruit and vegetables and offers the potential of extending the shelf life of "perishables."

It is in the lower range of dosage that the greatest progress has been made in both development and regulatory acceptance. The International Atomic Energy Commission and the Codex Alimentarius adopted guidelines for the use of irradiation in foods during the 1980s that permit radiation levels high enough for phytosanitary applications. Several European countries have led the way in applying this technology to destroy insects and other forms of infestation in highly perishable products such as tropical produce and seafood. The United States was somewhat slower to adopt standards permitting the radiation of food products, but the U.S. Food and Drug Administration adopted standards similar to those of the Codex.

The critical factor for a processing or marketing enterprise to consider in adopting this technology is not cost or quality control—both of which will, of course, create specific demands on the user—but market acceptance. Particularly in the United States, there is strong consumer resistance to irradiation, and FDA regulations require that processing by this means be disclosed on the label of the product. Consequently, large food companies have been reluctant to have their brand names associated with irradiation. They have not adopted this technology, despite its distinct advantages over many other forms of treatment, particularly for fresh perishables.

Before recommending this process, the analyst must ensure that adequate research has been conducted in the proposed market to demonstrate that consumer and intermediary resistance will not be a constraint to market penetration.

**Packaging.** The choice of product and the choice of market govern the basic packaging requirements, while the process dictates the standards related to preservation. In this section it is assumed that these specifications have been determined, and the discussion focuses on the factors
of concern in evaluating the materials and technologies available to achieve the set standards.

The cost of packing material in relation to total product cost. The financial importance of packaging decisions will depend on the share of packaging material in the total product cost. If packaging accounts for most of the direct costs, as in the case of many canned fruit and vegetable products, minor shifts in the cost of this component could put the product in a preferred market position or remove it from competition altogether. On the other hand, the package costs for high-value products such as meats or exotic fruits may account for only 10-15 percent of the total cost, and choices here will not have much impact on cost competitiveness. Since the packaging of products with a high value added is also related to buyer appeal, economizing on packaging can be detrimental to the marketing of such products, particularly when price does not greatly affect the purchasing decision.

Price trends among alternative materials. Prices can vary greatly among products made from natural and man-made materials: jute or sisal sacks versus those made from polypropylene, wood versus polyvinyl chloride crates, wood fiber versus styrofoam insulation. In each case, the basic industries concerned and the price of the commodities on which they are based are influenced by different factors. As a result, price trends vary and a comparison of spot prices or short-term trends will not be sufficient to give an accurate impression of relative prices over the life of the proposed processing enterprise. While each industry will not be relevant for all products, the basic industries in which price trends should be considered are wood and paper, metallurgy, natural fiber, and petrochemicals.

Availability. The availability of supply should also be examined from the point of view of the number of alternative sources, domestic or foreign, and the range of substitutability once the plant has been established. The objective here is to preserve the cost-effective options available to the firm in case it has to adjust to adverse supply and price developments.

Ease of use. In what form does the packing material arrive at the plant, and what operations must be performed on site before it can be used? The alternatives in the case of cans and the tradeoffs between transport cost and on-site preparation have already been pointed out. In the case of petrochemical materials, it may be desirable to purchase the raw materials in pellet or granule form and perform extrusion, weaving, or injection molding on site. However, these are capital-intensive operations that require precise control, and there are significant economies of scale to consider.
Recycling. Secondary packs—particularly sacks, boxes, and crates—can be recycled at significant savings, depending on the market distribution structure. In many cases recycling is associated with containers that provide an extra measure of product protection, usually at an extra cost. For example, fresh produce has for many years been shipped in cardboard cartons. Rigid polyvinyl chloride crates are fast becoming the norm in some markets, but their high cost makes recycling necessary.

In the beverage industry, glass containers are durable enough to be reused, and many enterprises around the world take back bottles and jars for refilling. In deciding whether to recycle, the analyst must examine the tradeoff between the cost of new containers and the cost of collecting, cleaning, and reconditioning old containers. Consumer convenience may mitigate against recycling, in which case the alternative is to reduce container cost by changing materials—switching, for example, to cans—or reducing the thickness of the glass and protecting it with a less expensive plastic sleeve.

Some recycled containers may have to be reprocessed. Glass has been handled in this way for many years in Europe, as are aluminum cans in many markets. The savings accrue in the first instance to the container manufacturer. The processor will only benefit if these savings are passed on or if consumer attitudes afford a market advantage to firms that adopt this “environmentally responsible” approach to their packaging.

The capacity of packaging equipment. By combining electronic controls with pneumatic, hydraulic, or electromechanical devices, engineers have been able to develop extremely fast packaging equipment. But its cost, skill requirements, and support services are commensurately greater. In assessing the required capacity for the enterprise, it is necessary to distinguish between those operations that are an integral part of the stabilizing process, as in the case of canning or aseptic packaging, and those that occur after stabilization has been completed, such as the bagging of pelletized feeds. In the former case, capacity will depend directly on other aspects of the processing operations, and a balance will have to be achieved to maintain the quality and the volume that the plant turns out.

Capacity standards are more flexible when packaging takes place after stabilization is completed, because the product may be able to enter a holding facility for deferred packaging. Depending on the form of the product, trays, hoppers, or snaking conveyors can provide this buffer between stages and enable the plant to operate at capacity for normal production periods without being hampered by a slower packaging oper-
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...This situation lends itself to labor-intensive packing methods, even in highly automated plants.

The precision of packing equipment. Developments in control systems have also increased the precision with which monitoring and mechanical operations can be performed. The same cost considerations apply here as in the case of capacity. Also, there is likely to be a greater demand for precision in packaging that is part of the stabilization process than the packaging that takes place at the end of the production line. Precision is normally more important where product safety is of concern rather than consumer appeal and is more important in the primary pack than in the secondary or bulking pack.

Damage rate on throughput. Some fraction of the packaged product will always be unacceptable for marketing. A small percentage of incomplete seals, broken jars, collapsed tins, and crushed cartons must be expected. For any level of management and operating skill, the share of such damage in total throughput will decline with the quality of materials and equipment used in packing. The decision concerning quality in this respect is one of marginal cost-benefit analysis.

To arrive at an accurate analysis of the effects of damage rates on performance, one must distinguish between two results of damage: (1) the value of the materials lost, which takes into account the possibility of returning contents in some cases for repackaging; and (2) the possibility that in many cases operations will have to be temporarily suspended. Here the cost lies not only in the lost materials, but also in the down time as well as in removing the damaged packs and restarting the line. This problem is usually associated with high-speed operations and those closely integrated with processing.

Storage and shipping operations. There are two main factors to consider in designing storage and shipping facilities: how to maintain product stability, and what storage capacity is required.

Product stability. Moisture level has great bearing on the stability of most dried products, but also on the quality of packing materials for products stabilized by other methods. It is therefore the foremost consideration in assessing the quality of storage facilities. In most cases, the moisture level at which the product is stabilized is the level at which it must be stored. Moisture-proof packaging affords a greater range of acceptable storage conditions, but totally impermeable materials are expensive, and most moisture-proof packages can be penetrated by some
moisture over time. Unpacked materials must therefore be kept in facilities featuring forced air and heating equipment, and packaged products must be kept in at least weatherproof warehouses with floors above ground level.

Bulk materials are subject to caking, even at low moisture levels, because of their weight and adhesion characteristics; the height of the piles and the shape of the hopper or silo must be specified with this in mind, and agitation and grinding equipment may have to be installed to facilitate unloading and packaging operations. "Bridging" is a serious safety problem related to caking. As stock is removed from the bottom of the hopper or silo, a cavity may form under caked material. The collapse of material above such a cavity could prove fatal to those working underneath and could damage the storage structure itself. Depending on the characteristics of the material to be stored, special equipment may be required to agitate the stock as it is removed and thus reduce the risk of cavities and bridging.

Dust formation is another problem associated with the bulk storage of dry materials. The dust of many agricultural products is highly explosive, and fatal accidents in bulk storage facilities are not uncommon. Sprays or cyclones may be needed to remove dust, and motors and moving parts may have to be placed in special housing to prevent sparks from igniting surrounding air.

Temperature is the other prime storage concern. Products that are stabilized through cooling or freezing must be kept at constant temperatures, which are specific to different types of products. The range of products will therefore determine the number of storage units to be maintained at different temperatures.

Most dry goods also require at least some temperature control. Temperature influences the rate of infectant activity at a given moisture level; it also affects the rate at which deterioration such as separation, oxidation, or osmosis occurs. Except under severe ambient conditions, artificial heating or cooling will not be required to keep temperatures in a satisfactory range for dry goods, but storage facilities should be built of materials with good insulating qualities and should be equipped with ventilation equipment. An accurate temperature monitoring system is essential to good storage.

Even if moisture and temperature are not a problem, most stored products need to be well ventilated to prevent condensation or hot spots. Ventilation is critical in bulk storage facilities. Perforated plates, ducts,
fans, and baffles should be incorporated in the structure to ensure that the entire product is subjected to air flow. The layout and stacking of packed goods should also take this factor into account, although access aisles are often sufficient to serve the ventilation needs of the product.

Storage facilities also need to protect products from insect, rodent, and bird damage and pilferage. While the exact problem will depend on product and location, normal precautions include sealed joints and properly fitted windows and doors; screened ventilated spaces; fumigation, depending on the products being stored; regular interior cleaning and removal of any materials near or in contact with exterior walls; locked entryways and surrounding fences; and a regular inspection and inventory control procedure.

Storage capacity. The storage capacity required depends on the difference between the production cycle and the marketing cycle. In agroindustrial enterprises, the difference in these cycles is often significant, and storage needs are much greater than are required simply for assembling shipment-sized quantities of a product.

In the worst case, a product may be processed during only a few weeks but then sold evenly throughout the year, so that storage capacity will need to be approximately equal to total processing capacity. This is a costly situation, particularly if cooling or cold storage are required to keep the product stable. To reduce storage costs under these circumstances, marketing and financial personnel should look into price incentives to encourage buyers downstream in the market chain to take early delivery of the product and thus carry some of the storage costs. Or it may be possible to identify other storage facilities that have a different cyclical use pattern, in which case a fair user charge might be negotiated that is lower than the cost of new storage capacity.

Storage requirements will also depend on the range of products to be stored, differences in the conditions to be maintained among products, and lot sizes for shipment. This last consideration will in turn depend on market structure, but also on the transport facilities used by the enterprise. In assessing the total storage requirements for the enterprise, the analyst should examine the possibility of alternating the storage of raw material and a finished good in a common space. The extent to which this is feasible will depend on the seasonality of the flow of raw materials in relation to the processing operations, the similarity of the storage conditions required for the two sets of goods, and the risk of contamination.
between them. Plant layout will also be a factor, as distance or interference in product flow lines adds to operating costs.

Shipping capacity should be determined by the lot size of shipment and the turnaround time required by the transport vehicles. The smaller the size of the shipment, the less handling and loading capacity will be required, and the greater the likelihood that a labor-intensive method will be appropriate. If shipments are to be large, loading time can be effectively extended by using containers. They can be loaded at a slower rate using labor-intensive methods in anticipation of the arrival of its vehicle or vessel. Mechanical loading is thus limited to container movement, but turnaround is not delayed. Replacement containers can be brought to the plant empty, or filled with third-party backhaul cargo, by trucks coming to collect outbound cargo. In all cases where mechanical handling equipment is to be used, goods should be palletized.

Environmental Considerations in Project Design

The environmental concerns surrounding a proposed enterprise will depend on its activity, technology, and location. If investors are to make responsible and appropriate decisions concerning environmental impact, the project analyst must take the following steps:

- Determine the dangers implicit in the specific enterprise proposal.
- Find out what environmental regulations the enterprise will have to observe and the trends in those regulations.
- Identify the technical or location alternatives or corrective measures to contain the risk.
- Incorporate into the investment analysis the financial and physical impact of operating in a manner that both complies with regulations and minimizes risk.

Investors and analysts often fail to arrive at responsible conclusions on environmental issues because there is little connection between the financial and the economic consequences of different choices. The economic cost to the community in terms of environmental damage may have no corresponding financial cost in the accounts of the enterprise. Yet the economic benefit to the community of reducing destructive activity may have an explicit financial cost on the books of the enterprise. The difference between financial and socioeconomic analysis is explored further in Chapter 7.
Today, agroindustrial enterprises are paying more attention to this issue. Regulations have been established that impose punitive costs for failing to adhere to minimum standards. Public sector assistance programs have created tax incentives and other inducements in the form of subsidies, reduced costs, and investment capital for enterprises that introduce specific environmental measures. In addition, consumer advocacy groups are promoting brand loyalty on the basis of the environmental sensitivity of the producer. It is now both socially responsible and financially rational for the analyst to examine the environmental aspects of a proposed investment. The discussion of each stage of operations earlier in this chapter will help the reader identify the points at which environmental problems can arise in any particular proposal (also see Table 3.1).

Table 3.1 General Types of Environmental Risk in Agroindustrial Operation

<table>
<thead>
<tr>
<th>Activity</th>
<th>Environmental Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Material Production</td>
<td>Erosion, soil depletion, siltation of waterways, and degradation of habitat</td>
</tr>
<tr>
<td>Land clearing and cultivation</td>
<td></td>
</tr>
<tr>
<td>Agrochemicals</td>
<td>Toxins and excessive nutrients in soil and surface and groundwater; also worker safety and product residues</td>
</tr>
<tr>
<td>Storage</td>
<td>Toxins related to product and worker safety</td>
</tr>
<tr>
<td>Pesticides</td>
<td></td>
</tr>
<tr>
<td>Processing</td>
<td>Toxins in concentrated or cumulative levels related to product safety and worker safety</td>
</tr>
<tr>
<td>Additives</td>
<td></td>
</tr>
<tr>
<td>Process</td>
<td>Toxins, heat, and mechanical activity related to worker safety; toxins related to product safety</td>
</tr>
<tr>
<td>Emissions</td>
<td>Toxins and solids</td>
</tr>
<tr>
<td>Effluent</td>
<td>Heat, oxygen demand, toxins, pathogens, solids, and pH</td>
</tr>
<tr>
<td>Marketing</td>
<td>Solids</td>
</tr>
<tr>
<td>Packaging</td>
<td></td>
</tr>
</tbody>
</table>
CONTROL OF EFFLUENT QUALITY. Most of the environmental risks associated with agroindustrial activities can be avoided by exercising quality control in the construction and operation of processing facilities. However, the liquid discharges from a wide range of agroindustries contain dangerous levels of pollutants, and some form of effluent treatment will be required. The principal categories of water pollutants are listed in Table 3.2, together with the treatments most suited to their removal.

**Table 3.2 Treatment Processes Suitable for Removing Contaminants Most Frequently Occurring in Wastewaters**

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>Treatment System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat</td>
<td>Heat exchangers</td>
</tr>
<tr>
<td></td>
<td>Cascade or spray coolers</td>
</tr>
<tr>
<td>Suspended solids</td>
<td>Sedimentation</td>
</tr>
<tr>
<td></td>
<td>Screening and comminution</td>
</tr>
<tr>
<td></td>
<td>Filtration variations</td>
</tr>
<tr>
<td></td>
<td>Flotation</td>
</tr>
<tr>
<td></td>
<td>Chemical-polymer addition</td>
</tr>
<tr>
<td></td>
<td>Coagulation/sedimentation</td>
</tr>
<tr>
<td></td>
<td>Land treatment systems</td>
</tr>
<tr>
<td>Biodegradable organics</td>
<td>Activated-sludge variations</td>
</tr>
<tr>
<td></td>
<td>Fixed-film variations</td>
</tr>
<tr>
<td></td>
<td>Biological contactors</td>
</tr>
<tr>
<td></td>
<td>Settling ponds/aeration</td>
</tr>
<tr>
<td></td>
<td>Intermittent sand filtration</td>
</tr>
<tr>
<td></td>
<td>Land treatment systems</td>
</tr>
<tr>
<td></td>
<td>Physical-chemical systems</td>
</tr>
<tr>
<td>Pathogens</td>
<td>Chlorination</td>
</tr>
<tr>
<td></td>
<td>Hypochlorination</td>
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<tr>
<td></td>
<td>Ozonation</td>
</tr>
<tr>
<td></td>
<td>Land treatment systems</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>Nitrification and denitrification variations</td>
</tr>
<tr>
<td></td>
<td>Fixed-film variations</td>
</tr>
<tr>
<td></td>
<td>Ammonia stripping</td>
</tr>
<tr>
<td></td>
<td>Ion exchange</td>
</tr>
<tr>
<td></td>
<td>Breakpoint chlorination</td>
</tr>
<tr>
<td></td>
<td>Land treatment systems</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>Metal-salt addition</td>
</tr>
<tr>
<td></td>
<td>Lime coagulation/sedimentation</td>
</tr>
<tr>
<td></td>
<td>Biological-chemical removal</td>
</tr>
<tr>
<td></td>
<td>Land treatment systems</td>
</tr>
<tr>
<td>Dissolved inorganic</td>
<td>Ion exchange</td>
</tr>
<tr>
<td></td>
<td>Reverse osmosis</td>
</tr>
<tr>
<td></td>
<td>Electrodialysis</td>
</tr>
</tbody>
</table>

### Table 3.3 Examples of By-products of Factory Waste

<table>
<thead>
<tr>
<th>Operation</th>
<th>By-Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar factories</td>
<td>Fuel for boilers, charcoal, animal feed, fertilizer/soil conditioner</td>
</tr>
<tr>
<td>Distilleries</td>
<td>Fertilizer/soil conditioner, animal feed</td>
</tr>
<tr>
<td>Meat and poultry processing</td>
<td>Blood meal, feather meal, fat</td>
</tr>
<tr>
<td>Fish processing</td>
<td>Fish meal</td>
</tr>
<tr>
<td>Rubber processing</td>
<td>Reclaim rubber</td>
</tr>
<tr>
<td>Palm oil processing (primary)</td>
<td>Fuel for boilers, animal feed, oil for reprocessing and soapstock</td>
</tr>
<tr>
<td>Wood processing</td>
<td>Fuel for boilers, charcoal for briquettes, pulp stock</td>
</tr>
<tr>
<td>Fruit/vegetable processing</td>
<td>Animal feed, soil conditioner</td>
</tr>
<tr>
<td>Grain milling</td>
<td>Fuel for boilers, animal feed</td>
</tr>
<tr>
<td>Oilseed pressing</td>
<td>Fuel for boilers, animal feed</td>
</tr>
<tr>
<td>Solvent oilseed extraction</td>
<td>Animal feed</td>
</tr>
<tr>
<td>Leather production</td>
<td>Glue, fertilizer</td>
</tr>
<tr>
<td>Dairy</td>
<td>Animal feed</td>
</tr>
</tbody>
</table>

In almost all cases, by-products of commercial value can be recovered from the discharge (Table 3.3). It is by no means universally true that by-product recovery is a commercially viable proposition, but the sale of recovery products has in many cases offset the cost of control measures and even generated a net income for the enterprise.

When examining by-product recovery options, remember to take into account the savings in reduced disposal costs, either in the form of reduced sewage charges or dumping fees, or smaller capital outlay for treatment facilities because of reduced capacity requirements or a reduction in the types of treatment required.

**Conservation and By-product Recovery.** Conservation is an important area of environmental protection in which some agroindustrial activities have performed poorly. The cost of additional raw materials or energy has historically been much less than the capital cost of more efficient technology. Also, by-product markets have tended to be narrow and prices low or unstable.

Energy efficiency has in fact been discouraged in some agroindustrial activities; waste disposal in sawmills and sugar factories, for example, is so problematic that if all waste materials could be consumed as fuel it has been considered a sign of “efficiency.”
Today, an energy-efficient sugar factory can meet its own power requirements and still produce 40 percent or more surplus bagasse. At field moisture, this bagasse has the same energy content as air-dried wood, more than peat, and up to 35 percent of the energy of coal (BTU/lb). This energy could be converted to electricity for sale to external users, including the national power grid. Molasses is often dumped because the cost of transportation exceeds its delivered price to most customers. Molasses dumped on land affects the structure and fertility of soil and gives rise to vermin; in water systems, its oxygen demand is a serious problem. Instead, this molasses could be converted to ethanol for fuel at the rate of 280 liters of hydrous ethanol per ton of molasses (average “C” molasses).

Conservation is now an integral part of project design as a result of significant increases in the cost of resource-based inputs and the price of available by-products. With the cost of energy and of some raw materials such as timber increasing, processing and marketing enterprises must find ways to reduce their consumption of these inputs per unit of output. In its simplest form, a conservation strategy must (1) minimize the use of materials, (2) minimize the use of energy, and (3) minimize waste.

Environment and Development Priorities

Different communities have different levels of concern for environmental issues. Some go as far as to say the environmental protection movement is a form of economic protection practiced by countries that are no longer dependent for their continued prosperity on the activities most damaging to the environment. Without debating the merits of this cynicism, the investment planner must at least recognize that the priority assigned to environmental issues in development policies varies from one community to another. Furthermore, the severity of many environmental risks also depends on location, so it may not be appropriate to impose the same performance standards universally.

A lack of concern for environmental issues is often due to a lack of knowledge of the dangers and alternatives at issue. Under these circumstances, responsible corporate behavior on the part of the investor would include apprising authorities of the risks inherent in the proposed investment and engaging in candid exchange on the effectiveness and cost of measures available to minimize these risks.
Evaluating Alternative Plant Locations

It is useful to recall at this point that design and evaluation are iterative processes, and that constraints encountered at any stage may force the analyst to reconsider the preliminary conclusions reached at earlier stages. This is particularly evident in the choice of technology and location. This section deals with the technological specifications for the processing enterprise and the range of variables to be considered in plant location. In fact, however, planners may have little choice in the location of the plant and therefore may be forced to reevaluate their choice of processing technology.

The important factors to consider when choosing a location can be grouped into nine main categories: process characteristics, raw material production pattern, site services, site conditions, horizontal relationships, socioeconomic conditions, incentives, regulation, and cost and terms of occupancy.

Process Characteristics

In most cases, the best plant location will be somewhere along the established transportation route between the source of raw material and the market. But applying that self-evident rule is more difficult. Should the plant be closer to the source of raw material or to the market? Certain characteristics of raw materials and process can guide this decision.

Processing should be performed near the source of raw material if (1) the raw material is more fragile or perishable in its unprocessed form than in the form in which it leaves the plant; (2) the process substantially reduces the weight or volume of the material to be marketed; and (3) the process does not require other inputs that themselves push up costs or are inconvenient to transport.

Processing should take place near the market if (1) the processed product is more fragile or perishable than the raw material; (2) the process adds weight or bulk to the product; and (3) the process requires other inputs that represent a significant transport factor and that originate in, or are distributed through, the market for the product of the proposed enterprise.

In general, primary processing is best carried out near the source of raw material, and secondary processing near the market.
Raw Material Production Pattern

The purpose in examining the pattern of raw material production and assembly is to find a location that will offer the most reliable flow of supplies and keep delivery costs to a minimum or offer a competitive advantage over other buyers. Although the ideal is to have producers deliver their product according to the plant's schedule and quantity requirements, this is seldom feasible and the collection and transport functions will become, at least to some degree, a direct cost to the enterprise. They are therefore explicit cost considerations.

Raw material supply patterns are discussed in Chapter 4. Among those of particular concern when choosing a location are the following:

- The geographic distribution of production. Where are the concentrations of producers, and where is production practiced most intensely? Could the enterprise alter this pattern, or is it likely to change as a result of other factors?
- Accessibility. What distance will have to be traveled, and what is the condition of the roads? Do different areas of production differ in these respects?
- Innovative farming practices. The existence of progressive practices indicates that producers can be expected to respond positively to the need for quality and efficiency in supplying the proposed enterprise. Does the pattern vary among groups of producers? Is there good research and extension backup for producers?
- The role of the raw material in the farming enterprise. Is it a core activity of the farm, which implies stability in its production, or is it a peripheral activity that might be neglected or abandoned if conditions are not favorable or if an alternate secondary activity comes along?
- The nature of commitments to other buyers. Is the raw material subject to credit arrangements or other commitments that make acquisition difficult for new buyers? Does this vary among groups of producers?
- Production trends. Are there recent developments in infrastructure, markets, or technology that are likely to change the importance of the raw material in the farm enterprise?
- Marketing system. Is marketing done through multipurpose relationships such as general merchants or credit sources? Is purchasing done in open markets at the time of harvesting, or through
some form of advanced contracting? Of particular interest here will be the differences among different groups of producers, and the location of established intermediaries.

In most instances, it will be cost-effective to use traditional marketing intermediaries, rather than establish a new collection system, if the enterprise can be reasonably assured of having a reliable and good-quality supply. In this case, the location of these intermediaries will be an important factor in plant location.

**Site Services**

The main details to consider in evaluating site services are the transport infrastructure, transport services, the water supply and disposal facilities, sewage services, communication services, and social infrastructure and services.

**Transport Infrastructure.** Transport requirements for raw material and finished goods may differ, and a compromise between the two may have to be reached in choosing a location. If finished product shipments tend to be large, rail or waterborne service will be a distinct advantage, and probably essential if the product has a low value-to-weight ratio. Road service will be appropriate in most cases, however, or it may be the only option. The quality of the road network will affect not only accessibility, but the cost of shipment, which must be either passed on to the buyer or absorbed as a cost disadvantage to suppliers who are served by a better road network. To assess the impact of differences among alternative sites in this respect, the analyst should prepare estimates of transport time and damage rates to vehicles and cargo.

**Transport Services.** Transport services will reduce the capital cost of the enterprise by eliminating the need to invest in transport equipment. This is not a viable option, however, unless there is enough competition among haulers to stabilize transport prices and keep them reasonable in relation to cost; in addition, the available equipment must be of the design and quality required to transport the raw material and final products of the enterprise.

Existing services could be enhanced through contractual arrangements with haulers that include equipment specifications. The processing
enterprise may even choose to prefinance any specialized equipment required to move its products. Such innovations will improve the quality of service to the enterprise, while keeping its costs below the level that would be incurred in establishing a separate transport division. By contracting for transport services rather than operating its own system, an enterprise can also ensure that the attention of its managers is not diverted from its core activities.

POWER SUPPLY. A dependable supply of electricity is an important advantage to consider in site selection. Although the cost can vary greatly from one location to another, electric power generation usually adds 30 percent or more to the investment cost if the enterprise has to produce its own power or have full-capacity stand-by equipment. On the other hand, even dependable grid power may not be adequate if the enterprise in question requires a large power capacity to drive mechanical machinery or if live steam must be generated because of the extent of heating, concentration, or drying involved in the process. If the process produces large quantities of combustible waste material, it may be cost-effective to install boilers and turbines, even if grid power is available.

Ready access to hydropower, coal, or natural gas would be an asset for enterprises that must generate large quantities of energy. Similarly, if diesel or bunker fuel is required, a supply must be assured at the site being seriously considered. The delivered cost of these fuels should be taken into account in the comparison of operating costs at alternative sites.

WATER SUPPLY AND DISPOSAL. Is sufficient water available from an established public supply system? If not, what surface or subsurface resources can be tapped? What is the capital cost of tapping these resources, and what are the operating costs? As with other technological alternatives, the analyst should be concerned with the reliability of supply, the total unit cost of water over time, and the fixed and variable shares of that cost.

Water quality is also a prime concern. If water is to come into direct contact with the product, it will impart chemical or biological elements that can affect health, safety, or market acceptance. In food processes, the water should meet standards for potability. Even if contact does not occur, water quality can affect the performance of equipment. For example, hard water will leave a crust in boilers, pipes, and valves; water with a high oxygen content will promote rust; and salts will promote corro-
SEWAGE SERVICE. Most processes that involve biological materials produce waste that requires special treatment facilities (see “Waste Disposal,” below). However, the cost of disposing of other forms of waste from the enterprise, such as human waste, and of site drainage, will normally be less if public sewage facilities are available.

COMMUNICATION SERVICES. Telecommunication and postal services are vital to most economic enterprises, but particularly to those that are dealing with perishable products and changing markets. Agroindustrial enterprises must be in constant touch with their markets and their suppliers. A good communication infrastructure at a proposed site will reduce the capital cost of establishing these links and increase the dependability of service.

SOCIAL INFRASTRUCTURE AND SERVICES. The existence of housing, schools, health services, and recreational and worship facilities near a proposed site will make the enterprise more attractive to workers and managers alike. This will have a direct impact on labor cost through reduced turnover rates and the ability of the enterprise to compete with alternative employment opportunities. Such facilities will also reduce the cost of providing the levels of health, safety, and convenience services that may be required under prevailing labor laws.

Site Characteristics

Planners need to pay special attention to four site characteristics: the area available, the topography, security conditions, and the ease of waste disposal.

AREA. Plant, storage, and administration buildings are the three basic components of most space plans. However, other facilities can take up a large share of the space. These include power plants that must be located at some distance from other buildings for reasons of safety, fuel depots, pumping stations, workshops and machinery depots, loading and unloading yards, marshaling areas, and areas for treating solid and liquid
waste. In isolated areas, housing and social amenities may also be required.

**TOPOGRAPHY.** The plant site needs to be level, well drained, and stable. The extent to which the site meets these requirements will depend on its topography and soil conditions. If fill is required to establish the necessary grade, or to stabilize the foundation and yard areas, is the appropriate material available at a reasonable cost?

**SECURITY.** Most enterprises will need to be enclosed with fencing. The nature and cost of this enclosure will depend on the topography of the site and its relationship to nearby structures.

**WASTE DISPOSAL.** Each product and process will have its own combination of solid and liquid wastes to dispose of, and site evaluation in this respect will be enterprise-specific. With a closed water system and a method of recovering waste by-products, the enterprise can reduce the amount of waste discharged, but even under the best of circumstances space must be available to stockpile solid waste and to treat water, for example, in settling or aeration ponds, before it is discharged into public sewers or waterways.

Several factors must be taken into account in choosing a location for stockpiling solid waste:

- **Fire hazard.** Fire is a threat even for moist material through spontaneous combustion. Waste must therefore be isolated from the plant and from community facilities, natural growth, and crops. During dry seasons, or periods when spontaneous combustion is a serious risk, a sprinkler system may be needed to water down stockpiles. Distance from water and power sources will affect the cost of this operation.
- **Nuisance.** Fermentation or other natural processes that take place in waste material generate offensive odors that can upset community relations.
- **Pests.** Stockpiles may lead to the buildup of pest populations that can be harmful to the nearby enterprise or to adjacent communities.
Convenience. If the material is to be periodically removed to a final disposal site, or if it is to be recycled as fuel, it will be necessary to ensure convenient access for loading and hauling equipment.

For liquid waste disposal, the suitability of disposal facilities will depend on the type of pollutants in the liquid. The main groups of pollutants are heat, toxic materials, oxygen-consuming materials, and inert solids. In each case, one or more of the following factors will need to be considered:

- Area. Many enterprises will require settling tanks. Such facilities may serve to cool the discharge water, promote aerobic decomposition of biological materials, or permit gravity separation of inert solids. Space requirements will be a function of the volume of discharge water and the period of time required for the purification process. There is some scope for space reduction by substituting capital equipment such as cascade coolers or aeration pumps to accelerate oxidation. In the case of sedimentation processes, it may be necessary to periodically relocate the tanks.

- Topography. Natural depressions can reduce or eliminate the cost of creating settling tanks, and different elevations can be exploited to promote gravity flow rather than pumps.

- Subsoil conditions. If percolation rates are high or bedrock fissures are large and deep, tanks may have to be lined. If the percolation rate is consistent with the decomposition of pollutants that occurs in the tank, this will reduce discharge costs.

- Location in relation to power source. If pumps are required to agitate or discharge the waste material, or to aerate it to promote oxidation, convenient access to power will be an important consideration.

- Location in relation to natural waterways. The opposing considerations here are the risk that the material will seep from the tank before purification is complete, and the ease with which the neutralized material can be discharged. Access to surface water may also be useful if the concentration of the discharge liquid must be altered during decomposition.
Lateral Relationships

One of the attractive development features of agroindustrial enterprises, particularly those engaged in primary processing, is that they do not require as many industrial links as other types of industry. Vertically, they take a farm product, incorporate a small range of other ingredients and packaging materials, and sell it to consumers or to secondary processors that are not geographically dependent on the enterprise. However, these enterprises also enter into important lateral relationships, some of which are required for the production operation, and some of which have an indirect effect on performance.

- Repair and maintenance services are vital for small and medium enterprises that cannot afford to maintain these services themselves. However, even large plants benefit from having independent sources of spare parts and skilled technicians.
- Transport services are discussed elsewhere.
- Complementary enterprises can constitute a market for waste materials and by-products.
- Other enterprises can subcontract parts of the proposed process, for example, storage. This reduces the capital investment required by the new enterprise and creates mutually beneficial relationships with established business in the community.
- The existence of other enterprises nearby creates labor and management pools with common or associated skills.
- The combined effect of a number of enterprises is that they create a critical mass of employment and purchasing power that can enhance the effectiveness of representation efforts with local authorities.
- The existence of other enterprises in the area indicates that local authorities are familiar with the needs and benefits of industrial members of the community.

Socioeconomic Conditions

Alternative sites need to be assessed in terms of the availability of labor and management personnel. Their numbers, cost, and skills in relation to enterprise needs should be examined separately. Are there seasonal fluctuations in supply as a result of farming or other competing demands? Will working conditions in the plant be similar to those with which pro-
pective employees are familiar, and if not, are there cultural patterns such as work habits, family structure, or holidays from which compatibility can be assessed?

If labor or management personnel are to be brought into the area, the setting must be appraised to see if it has the amenities that will encourage personnel to stay. Schools, recreational or cultural activities, housing, and health and shopping facilities are the most critical considerations in this respect. The benefits of being able to retain employees are both indirect (in terms of familiarity and loyalty) and direct (lower training costs and higher average productivity). Modest expenditures on training facilities, housing, and social facilities will usually be a financially sound investment in relation to these benefits.

**Incentives**

Many governments offer incentives to prospective investors. These range from subsidized sites and services to low-cost loans, import privileges, and tax holidays. Eligibility may be related to the size of the fixed investment or the number of employees; other conditions may be related to the share of local raw materials in production costs or the purchase of other local goods and services.

The national investment code sets out many of these benefits, but those of a provincial or local nature may need to be identified through more thorough research. In all cases, the analyst must examine the administrative cost associated with these benefits; the application and processing effort may be considerable. The operating constraints imposed by the conditions of the benefits need to be considered as well, as they may make it difficult for the enterprise to adjust to changing circumstances or may subject it to monopoly supply situations.

Many incentives are related to export performance, and availing oneself of these may restrict or preclude entry into the domestic market. Developments in recent years have made the domestic markets of developing countries more attractive than traditional export markets for many agricultural products, and this trend will continue as urbanization and incomes expand. The analyst must therefore consider the prospects for the products of the proposed enterprise in weighing the benefits to be gained under incentive schemes.
Regulations

Responsible corporate behavior means that proper standards will be followed with respect to employee compensation and safety, and adequate measures will be taken to protect the environment of the enterprise. However, there will be specific regulatory provisions for these and other factors, and they must be considered in site selection.

Labor Laws. Aspects of labor law that the analyst needs to consider are wage rates, benefit packages, the right of workers to organize and to engage in collective bargaining, employment and termination procedures, negotiation and appeal procedures, the provision of housing and other amenities, job training, safety standards, and on-site facilities such as lunch rooms, sanitary facilities, and day care for children. In complying with labor law requirements, the enterprise may spend an amount equal to or greater than the basic wage cost of labor. The conditions at alternative sites may differ in relation to the facilities and services required, and some regulations will differ among municipalities.

Building Codes. Two of the most common components of building codes—site specifications and structural requirements—are often set up to mitigate the effects of disasters such as flood and earthquake. They therefore vary considerably from one site to another, depending on the conditions in the area. Codes also include standards for electricity, plumbing, and heating installations. All of these provisions will have a direct bearing on construction costs. Other elements of the code—such as height restrictions, easements, set-backs, and the isolation of power plants—will affect the usable space of a given site.

Zoning Regulations. In most cases, zoning regulations will determine whether the proposed project can go ahead, because they will indicate the types of activities that can be undertaken on the proposed site. In other cases, density limits will determine the intensity to which a site can be developed. If a site offers particular advantages for the principal activity of the enterprise, it may be appropriate to consider conducting ancillary activities elsewhere that do not conform to zoning requirements. However, this approach creates additional logistical and management problems.
ENVIRONMENTAL REGULATIONS. Because environmental regulations are rapidly changing at present, those planning a new enterprise should expect to see more emphasis on environmental impacts if comprehensive regulations are not currently in force. Environmental concerns related to the particular activities of the enterprise will include liquid and solid waste disposal and treatment, fumes, smoke, noise, and odor. Standards are likely to vary with site characteristics, such as proximity to natural waterways, proximity to residential or urban concentrations, prevailing winds, and topographic features that affect air and water movement.

Cost and Terms of Occupancy

Price comparisons alone are not a sound basis for selecting a site. Only after the factors identified above have been evaluated are planners in a position to assess the value of a proposed site in relation to its price. Then the analyst must examine the terms of occupancy. Is tenure secure for at least the economic life of the investment? In the event of purchase, what are the terms of sale and the cost of credit? Is it useful to consider offering the seller an interest in the enterprise in lieu of full cash or credit payment? Are there tax or cash flow benefits to be gained from leasing rather than purchasing the land? Do the terms of occupancy permit subdivision or leasing to generate cash flow from space that is either temporarily or permanently unnecessary for the enterprise?

Developing Input Specifications

In the first part of this chapter, market information from Chapter 2 was used to determine the most appropriate mix of outputs. Next, these specifications were used with other considerations to select the appropriate layout and technology for the processing plant, and then its location. The final step in designing or evaluating the processing plant is to specify the input requirements. This is a transitional stage, in which the needs of the processing plant and its customers are interpreted in terms of agricultural factors that will guide those designing the supply system for the raw materials, which is examined in Chapter 4. Raw material requirements should be specified in terms of quality, quantity, and the timing of deliveries. Specifications must also be developed for other inputs.
Quality of Raw Material

When processing is introduced into the marketing chain of a farm product, the factors and standards of quality are no longer the same as those that prevail in the fresh market. Traditional varieties and production practices are adequate or even superior in meeting the preferences of direct consumers in the local market, but the rigors of processing and the preferences of different consumers place new demands on the raw material.

To ensure that these factors are adequately reflected in raw material specifications, quality should be examined with respect to market acceptance, processing quality, and processing efficiency.

MARKET ACCEPTANCE. The quality factors by which to judge a product will depend on the market and product. The most common factors are summarized below:

- Household market, food: color, aroma, uniformity, texture, flavor, nutrition, and purity
- Household market, nonfood: color, uniformity, texture, durability, and serviceability
- Industrial market, food: color, aroma, uniformity, shape, size, texture, flavor, nutrition, purity, and composition
- Industrial market, nonfood: color, uniformity, texture, durability, serviceability, size, shape, composition, and foreign material.

The relative importance of these factors for our selected products and markets must be established and expressed as standards to be applied in raw material selection and pricing.

PROCESSING QUALITY. It is important to recognize that processing will affect these characteristics, and that post-processing quality is the primary concern. For example, canning tends to break down fruit and vegetable structure and to infuse the material with other liquids such as syrup or brine used in the process. Therefore, the raw material that is used needs to be firmer than that typically preferred in the fresh market, and it need not be as juicy. It is the job of the food technologist and the engineer to minimize the detrimental side effects of processing, but for any given technology some varieties or forms of raw material will be more adversely affected than others. The most common problems are:
The Selection and Evaluation of Processing Options

- Mechanical processing: breakage, separation, and nutrient decomposition
- Heat treatment: loss of texture, color, flavor and aroma, and nutrient decomposition
- Cold treatment: loss of structure or texture
- Pressure treatment: loss of texture, color, flavor, and aroma and nutrient decomposition.

If the proposed enterprise is to use new raw materials or new processes, pilot operations will be necessary to determine the effects of processing on the varieties of raw material that can be produced under the conditions that prevail in the production area. If the results are not satisfactory, changes may be possible both in the raw material production system and in the processing equipment. Failure to undertake this pilot phase adds to commercial risk and can lead to costly modifications and delays if adaptation is undertaken after plant construction.

**PROCESSING EFFICIENCY.** The efficiency with which a raw material can be processed is determined by three factors.

- Composition of raw material. The proportion of desired components in the material. For example, sucrose in sugarcane, oil in cottonseed, and juice in citrus.
- Recovery rate. The degree of extraction of the desired components from the structure of the raw material. For example, the percentage of sucrose in cane or oil in cottonseed that is extracted as the finished product; dress weight in livestock processing.
- Cost of recovery. The relative ease with which extraction can take place. For example, the release of sucrose from the cane fiber, or the removal of feathers from poultry.

In any given process, these factors will vary with the type of raw material, as well as its size, shape, maturity, condition, and uniformity. Each of these dimensions should be specified for the benefit of those in charge of establishing the raw material supply system. Such dimensions are closely related to breed or variety as well as husbandry, and the selection of planting material or parent stock will be an important aspect of developing the raw material specifications.
Agroindustrial Investment and Operations

Quantity of Raw Material

Marketing plans and the design of the processing facility will dictate the minimum and maximum quantities of raw material needed for successful operations. As discussed in the section on receiving operations, it is also important to specify lot sizes to be delivered and the limits of quality variation acceptable in individual shipments.

Delivery Schedules

The processing facility will have a maximum rated capacity, usually expressed in tons per hour or shift. Raw material deliveries need to be scheduled in accordance with that capacity, particularly if they are highly perishable. Otherwise, expensive storage facilities will be required or losses will occur.

At the same time, all plants have costs such as the production of energy that are "semifixed," in the sense that the shift manager can decide whether or not to incur them, but once incurred, they are not closely related to volume of throughput. They will result in high per unit charges if the plant is not operating near its rated capacity. If adequate raw materials are not available to ensure this level of operation, it is often better to shut down the plant and absorb the fixed costs associated with idle time rather than continue operating at a low volume. This is particularly true of processes that require steam for heating and power.

The scheduling of deliveries is therefore critical. For highly perishable materials, scheduling may need to extend as far back as to specify planting or harvesting times for individual suppliers. In other cases, temporary storage at buying points or assembly points may be an appropriate means of smoothing out plant deliveries.

Other Inputs

Quantity, quality, and scheduling will also be important considerations for other inputs. However, in most cases these will not be as perishable as the raw material. In addition, their quantities will be smaller, with the result that larger, less frequent purchases may be appropriate to obtain price advantages. Consequently, the plant's storage facilities should be large enough to hold supplies for several weeks or months of operation. The design of these facilities will be dictated by the characteristics of the
materials in question, and size should be determined by applying normal inventory management techniques, notably, use rates, order and delivery times, lot size, fixed purchasing costs, storage costs, the terms of purchase (including quantity discounts), and the cost of capital.
4

Raw Material Supply

The function of the raw material supply system is to deliver the right quantity and quality of inputs to the processing facility in a timely manner and at a reasonable cost. The needs of the processing facility with respect to each of these dimensions—quantity, quality, timing, and cost—will be determined for the most part in the analyses conducted during the marketing and processing phases of project design. The development of input specifications for the processing plant was discussed in the concluding section of Chapter 3. This chapter examines how to meet those specifications through an effective production and collection system.

The Basic Components

Three distinct components of agricultural production must be considered in designing and operating a raw material supply system: the product, the producer, and the market. Although each set of circumstances will be unique, these components will have the same basic characteristics in most situations.

The Product

Agricultural products are seasonal, perishable, and variable. A good procurement system is one that pays close attention to these traits in the particular raw material and that employs the technology, infrastructure, and organization needed to optimize the performance of the agroindustry.
The Producer

The first concern of traditional farmers is the high risk associated with agricultural production and the narrow margin that typically exists between average production levels and subsistence needs. For this reason, producers will resist innovation unless they can clearly see the benefits of change and the measures that can be taken to minimize this risk.

The Market

In traditional agricultural communities, the marketable surplus is typically sold through a diffuse and multilayered network reflecting the geographic dispersal of production, the large numbers of small-lot suppliers, and the complex multifunction relationships in rural communities.

Within this environment, the agroindustrial enterprise must compete at two levels. First, at the production level, farm units have a range of agricultural and nonagricultural employment alternatives, and the enterprise must induce them to produce the desired raw material. Second, at the market level, the enterprise must compete to secure an adequate share of production. Depending on the existing production pattern and market structure, this may be achieved simply by entering the market with competitive prices and terms. More often, however, some degree of intervention will be necessary to alter the product, the production process, or the market structure. The most difficult aspect of procurement is understanding existing production and marketing systems and assessing the impact of alternative forms of intervention.

It is at the level of raw material supply that an agroindustry encounters directly the cyclical and climatic variables that distinguish this type of industry from others. The production of agricultural raw materials has some other distinctive features. It is typically part of a multiproduct unit—the farm—which has a variety of production possibilities; there are usually many prospective suppliers, and a variety of marketing arrangements; in traditional communities, at least, financial and commercial decisions are more closely linked to socioeconomic factors than is the case in other types of primary industry.

The design of the supply system must therefore be based not only on a clear understanding of delivery requirements, but also on a thorough knowledge of conditions in the prospective supply area. With these two sets of information in hand, the analyst can define raw material require-
ments in agricultural terms suited to the supply region and address organizational aspects of the supply system.

Understanding the Potential Supply Area

A good understanding of the existing rural economy is essential to the design and operation of an effective supply system. Whether the enterprise is new to the area or is planning to expand or diversify its activities, it can gain valuable insights from a survey of the resources, activities, and trade relationships of its potential suppliers. Some of this information can be obtained from secondary sources, but in most cases field observations and interviews will also be necessary.

Although the questions of primary concern in a survey will depend on the location and commodity, the survey should cover the following topics: overall land-use pattern, land tenure, agricultural production patterns, demographics and employment, transportation and support services, financial services, trade patterns, and socioeconomic structure. The reasons for investigating each of these topics and some of the concerns connected with each are summarized below:

**Overall Land-Use Pattern**

*Purpose.* To identify the size and spatial relationship of the areas most suited to the production of raw material.

*Scope.* Location and use of irrigated and rainfed cropland, distribution of tree crops and marginal land, pasture and forests.

**Land Tenure**

*Purpose.* To identify who controls land use and assess the autonomy and motivation of producers in making alternative product decisions.

*Scope.* Size and distribution of holdings, ownership and tenancy patterns, terms of tenancy and security of tenure.

**Agricultural Production**

*Purpose.* To assess the relative importance of the raw material in the farm enterprise and the extent to which activities and skills must be changed to achieve the desired production; to assess possible displacement effects.

*Scope.* Productive activities of the farm enterprises; interdependence in terms of the crop cycle, the use of labor, crop residue and livestock by-
products; the level of technology and capital used in production; level of surplus production; extent of unused land, labor, and equipment.

**Demographics and Employment**

**Purpose.** To assess the labor demand and seasonality and how it might change as demand for the raw material increases, either in terms of the need to hire farm workers or the displacement of family labor.

**Scope.** Farm family size; share of family labor employed on-farm, off-farm, and unemployed; size and nature of landless labor force in the area; location and type of off-farm employment; migration and urbanization pattern; education and training facilities.

**Transportation and Support Services**

**Purpose.** To determine the extent to which facilities and services are adequate for growers who choose to produce for the enterprise.

**Scope.** Regional and farm-to-market road system, transportation and communication services, input suppliers, research and extension services.

**Financial Services**

**Purpose.** To determine if adequate financial services are available to producers, if they are familiar with savings and credit facilities, and if their credit performance has been satisfactory.

**Scope.** Area covered by financial institutions (branches and types of service), range and terms of credit facilities, savings and credit portfolios, credit extended to producers, and collection performance.

**Trade Patterns**

**Purpose.** To estimate the surplus available for direct purchase, assess the adequacy of trade facilities, and identify competitors and potential procurement intermediaries.

**Scope.** Flow of production inputs and farm produce; share of produce sales tied to input, consumption, and credit facilities; share of untied marketing; average prices and seasonal fluctuations; characteristics of buyers and marketing channels; quality, capacity, and location of facilities for trading, assembly, and storage.
Socioeconomic Structure

Purpose. To identify cohesive groups of producers as potential suppliers, group leaders who could act as intermediaries, loyalties that could create resistance to supplying raw material to the proposed new enterprise, and the nature of ancillary services producers may expect from other segments of the community.

Scope. Common characteristics around which groups develop; formality and cohesiveness of groups; group leaders and their influence over members; pattern of producer dependence on other members of the society such as landlords, merchants, and professionals for information, advice, inputs, consumption goods, credit, and markets.

The cost of conducting this survey will depend on the circumstances in the supply area. Four techniques can help reduce costs and increase the usefulness of the data collected.

1. Spend time identifying the existing sources of information. Use these to the extent that their age and scope permit, and conduct fieldwork to verify information and to resolve inconsistencies in the data.
2. Develop standard questionnaires for each group of respondents to ensure that field interviews can be efficiently carried out, that the necessary information is collected in each case, and that the results can be aggregated.
3. Use stratified sampling techniques to minimize the amount of fieldwork to be done.
4. Design the survey so that special technical and interpretive expertise will not be required to tabulate the results.

A Note of Caution

Specialists tend to interpret the phenomena they encounter from the perspective of their own areas of expertise. The economist, for example, might say that a producer has decided to sell to a particular buyer because of the price offered, whereas the sociologist will argue that certain relationship factors led to the decision. Each may be right to a degree, but in the final analysis, the proposed enterprise will succeed in attracting suppliers only if it has correctly determined which of these factors is most important. If conclusions are reached too hastily, apparent anomalies may go unexplored, only to reemerge as problems at a later stage because the
fundamental reason for the pattern was not uncovered at the time of the survey.

Defining Raw Material Requirements

The input specifications for the processing facility (see the last section of Chapter 3) must now be examined more closely. The present task is to determine the agricultural, financial, and organizational factors that affect them and how they are related to the prevailing patterns identified during the survey of the supply area. The discussion is organized around quantity, quality, timing, and cost for each specification.

Quantity

The quantity available for purchase by the enterprise will depend on the producer's productivity, the price offered to him, and trade commitments that prejudice the sales decision. Several steps can be taken to assess these factors.

First, estimate yield ranges for the production of raw material under local conditions, using several levels of improved inputs. Use these to estimate the production area that would be needed to meet the needs of the enterprise.

Second, prepare financial models to compare the net benefit to the farmer of producing the raw material in question with the benefit of other activities. Price assumptions will be critical; different tests should be run using historical price trends as well as the limiting price imposed by the financial analysis of the enterprise. Compare these results with cash inputs and labor requirements.

Third, identify other factors such as budget constraints, labor shortages, interdependence among activities, and obligations to other buyers that must be considered if producers are to respond to the financial benefits estimated in the second step.

Fourth, the information from the first three steps will give a preliminary indication of likely producer response to the opportunity to sell raw material to the proposed enterprise. This information can be used to estimate the evolution of raw material quantities that are likely to be offered to the enterprise in the first several years of operation as it establishes facilities and relationships in the supply area.
Quality

At least three steps must be taken to ensure that a steady supply of raw material is available to meet the input specifications of the enterprise:

First, establish basic standards for quality that can be recognized by producers and those who will provide them with production assistance. Second, ensure that producers have the necessary inputs and know-how to meet the desired standards. Third, provide the producers with incentives to meet the desired production and delivery standards.

Quality in the production process is directly related to the planting or breeding material, husbandry, fertilizers or feeds, pesticides or disease control, harvesting, and postharvest handling. The aspects of quality influenced by each and the related control factors are summarized in Table 4.1.

Table 4.1 Quality Determinants and Control Factors in Plant Production

<table>
<thead>
<tr>
<th>Quality Determinants in Plant Products(^a)</th>
<th>Related Aspects of Quality</th>
<th>Control Factors of Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Planting material</td>
<td>Size, uniformity, appearance, texture, and composition</td>
<td>Variety, condition</td>
</tr>
<tr>
<td>2. Husbandry</td>
<td>Size, uniformity, and purity</td>
<td>Land preparation, planting time and technique, pruning, pest control, and water management</td>
</tr>
<tr>
<td>3. Fertilizers and pesticides</td>
<td>Size, purity appearance, and composition</td>
<td>Type, quantity, timing, and method of application</td>
</tr>
<tr>
<td>4. Harvesting</td>
<td>Maturity, composition, appearance, and damage</td>
<td>Timing and method of harvest</td>
</tr>
<tr>
<td>5. Postharvest management</td>
<td>Maturity, composition, appearance, damage, and purity</td>
<td>Delivery time, exposure to the elements, and handling</td>
</tr>
</tbody>
</table>

\(^a\) A similar relationship exists among the determinants and control factors for animal products. The principal determinants in that case would be breeding stock, husbandry, feed and health, assembly, and transport.
Timing and Seasonality

In most cases, the objective is to smooth out and extend the normal harvest period. Although the seasonal and biological cycle will impose limits on flexibility, several factors can be used to alter production patterns.

Species and Variety. The maturity period can vary significantly among varieties of the same species. One of the simplest means of extending the harvest season is to strategically select those varieties that meet quality standards. Many processing facilities are also designed to handle different species, for example, different fruits and vegetables. In areas of mixed farming, this strategy enables the processing plant to operate for almost the entire growing season.

Planting Dates. Planting dates are closely tied to climate (usually the availability of water), the maturity period of traditional varieties, and the capacity of draft power to prepare the soil. Irrigation or artificial crop drying can alleviate the climate constraint on planting dates; the other constraints can be addressed by substituting a different variety and using heavier equipment to prepare soils earlier in the season. Different cultivation practices such as minimum tillage may also be appropriate.

Inputs. Growth accelerators and sprays to induce flowering have been developed to alter the maturity period. For some plants, fertilizer can also extend or shorten the vegetative phase of development.

Microclimates. Even within small areas, the climate and soil conditions can vary enough to alter the maturity period of plants. Identifying and scheduling these areas in the procurement process is an inexpensive means of smoothing out deliveries.

Grower Incentives. To induce growers to adopt the practices referred to above, or to reward extra management and labor effort, the enterprise can adjust prices offered to producers in relation to desired delivery dates. Convenience can also be used as an incentive by rotating purchasing points or providing transport facilities.
Cost
In the absence of price regulation, the price of raw material is determined by (1) the competition the enterprise must face in trying to purchase its supplies, and (2) the level that income must reach to keep the producer interested in producing the raw material. As discussed in the section on organizing the procurement system, some forms of assistance such as credit can enhance grower participation at any given price level. In addition, cash payment at the time of delivery and convenience of the transaction can encourage the producer to sell to the enterprise.

In assessing cost, remember that it is the cost delivered to the processing plant, not the farmgate price, that is critical for the enterprise. In the event of scarcity or increased competition, the enterprise may need to consider paying higher prices temporarily; in setting a ceiling price for such periods, the analyst should take into account the fact that the unit cost of processing will decline when throughout is maintained at levels close to the rated capacity.

Alternative Ways of Procuring Raw Material
The manner in which an agroindustry procures its raw material has an effect not only on the viability of the enterprise, but also on the rural community. Therefore, it is not surprising that this subject has been widely studied and that some analysts put primary emphasis on the welfare of the rural community and others on the viability of the enterprise. Producers and processors have far more in common than is implied by this dichotomy. The remainder of this chapter focuses on determining the most suitable arrangements for both parties.

Selecting the Appropriate Procurement System
The process of selecting the most appropriate supply system consists of three stages: defining raw material requirements, surveying potential supply areas, and assessing the inherent characteristics of alternative supply systems. The first two stages were examined in preceding sections of this chapter.

In their simplest form, the basic alternatives available to an agroindustry are to buy raw material or to produce it. If the material is to be bought, it can be purchased in the open market or under some form of contract, the essence of which is an agreement to purchase, entered into before the
actual sales transaction. Each of these systems is widely practiced, as are combinations.

The principal factors to consider in choosing a system of procurement are cost, control, and flexibility. Although it is customary to think of the agroindustry as the party doing the choosing and to examine these factors from the point of view of the enterprise, the producers must also choose how to sell and to whom, and the same factors govern their choice.

Table 4.2 summarizes the cost, control, and flexibility implications of different procurement systems for the enterprise and for the producers.

Whether the system that is selected is suitable and will remain stable over time depends largely on the negotiations that take place between the enterprise and its raw material suppliers. Unfortunately, the “negotiation” often amounts to a series of signals from one party to the other through unilateral action. A mutually recognized process of negotiation is preferable, either directly or through intermediaries, such as producer groups or community leaders. In any event, it is important to understand the choices and constraints faced by the other party in order to arrive at a more favorable procurement arrangement.

Matching information from raw material specifications and the area survey with the inherent characteristics of alternative supply systems will seldom result in a perfect fit with any one alternative. What usually happens is that the most appropriate system or combination of systems is identified in this manner, along with the remaining issues on which detailed design and organizational work must focus. It is useful to summarize the conditions under which the alternative procurement systems usually function.

**Conditions under Which Alternative Supply Systems Usually Function**

1. The agroindustrial enterprise will tend to produce its own raw materials if
   - The commodity quality varies greatly, but processing requirements are specific.
   - Production technology is proprietary.
   - There is potential for large-scale mechanization or other economies of scale.
There is need for capital improvements such as land leveling, irrigation, or drainage.

- Producers have integrated downstream to become processors.
- The market is fragmented or oligopolistic.
- Multiservice relationships prevent new buyers from entering the market.
- There is a lack of infrastructure or supporting services.

2. The enterprise will tend to buy its raw materials under contract if

- The commodity has variable quality that can be influenced by inputs and husbandry.
- The commodity is perishable or cannot be consumed in the raw form.
- The commodity has a relatively high ratio of value to weight.
- Producers are members of groups with similar socioeconomic characteristics.
- Productive farm resources are available above subsistence needs.
- Basic transport and trade infrastructure is in place.
- Markets are not competitive; limited buyers and sellers.

3. The enterprise will tend to buy its raw materials on the open market if

- The commodity is uniform or there is a wide tolerance for quality in processing.
- Production is labor-intensive, with limited economies of scale.
- Specialized inputs are not significant.
- The commodity is a short-term crop that could, as an alternative, be consumed in raw form.
- A good level of technology is already being practiced.
- There is a good flow of information and inputs to producers.
- There is a competitive market with many buyers.
- There are good infrastructure and supporting services.

Organizational problems and the need for coordination are least significant when the raw material can be procured in the open market. As some of the conditions listed above suggest, this system is also most common in areas that have achieved a relatively advanced degree of development. At the other extreme, a conclusion that the enterprise should produce its own raw material may imply that the rural economy is at a much earlier stage of development. Paradoxically, in this case the organi-
Table 4.2 Implications of Alternative Raw Material Supply Systems with Respect to Cost, Control, and Flexibility

<table>
<thead>
<tr>
<th>Factor</th>
<th>Enterprise Produces Its Own Raw Materials</th>
<th>Enterprise Buys Raw Material under Contract</th>
<th>Enterprise Buys Raw Material in the Open Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>Full production cost including land, improvements, and capital equipment</td>
<td>Administrative cost of contract</td>
<td>Purchase price of raw material</td>
</tr>
<tr>
<td></td>
<td>Additional resources required to manage labor and the production function</td>
<td>Risk of unrecovered cost of</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- input procurement and distribution</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- technical assistance</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- custom hire services</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- finance charges</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>Maximum control over the production function, subject to available resources</td>
<td>Influence over planting material, other inputs, husbandry, and delivery</td>
<td>None, other than through incentives</td>
</tr>
<tr>
<td></td>
<td>Maximum exposure to risk of acts of God</td>
<td>Reduced risk regarding quantity, quality, and timing of supply</td>
<td></td>
</tr>
<tr>
<td>Flexibility</td>
<td>Limited by the investment in production</td>
<td>Changes in the length and terms of the contract</td>
<td>Fully flexible</td>
</tr>
</tbody>
</table>
(B) Implications for Independent Producers if

<table>
<thead>
<tr>
<th>Enterprise Produces Its Own Raw Materials</th>
<th>Enterprise Buys Raw Material under Contract</th>
<th>Enterprise Buys Raw Material in the Open Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not applicable</td>
<td>Higher production costs through improved inputs and more intensive husbandry. May also require investment items</td>
<td>Normal production costs; may choose to incur additional costs to respond to incentives.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not applicable</td>
<td>Secure outlet for production Predetermined price formula Limited by negotiating strength, market alternatives, and indebtedness</td>
<td>Maximum control, subject to resources, acts of God, and market conditions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lease or sale of land to the enterprise</td>
<td>Alter share of resources and output committed to the contract Alter the degree of rigor in conforming to the production package Choice in disposing of nonconforming and surplus production</td>
<td>Fully flexible as to commodity, production package, and market.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
zational issues are also relatively straightforward inasmuch as decisions and control are vested in the enterprise itself.

It is the desire for control that may lead an enterprise to favor producing its own raw materials when it is not necessary to do so. This course of action can cause greater social and economic disruption than would occur if supplies were secured from other producers. The agro-based enterprise must recognize what impact it can have on its rural community if these disruptions are to be kept to a minimum. (See discussion of socioeconomic impact.)

Nucleus Estate/Outgrower Supply Systems

In many cases, the initial survey will indicate that the enterprise should use a combination of procurement systems, whereby it produces a portion of the raw material it needs and purchases the balance under contract from other producers. Known as a Nucleus Estate/Outgrower System, or Core/Satellite System, this combination offers a number of advantages if a significant quantity of raw material is required.

- The enterprise can ensure that a share of its needs is supplied irrespective of outgrower performance.
- The nucleus estate can serve as a testing and demonstration facility.
- The nucleus estate provides a standard by which to measure outgrower performance.
- The nucleus estate can accommodate nursery facilities for the production of planting material for outgrowers.
- The buildup of outgrowers can take place more gradually, with demonstration and experience.
- The supply of inputs to outgrowers may be accomplished at less cost by distributing through the nucleus estate, which can procure inputs in large quantities.
- Improvements in extension, distribution, and marketing infrastructure to serve outgrowers can also be phased.
- The nucleus estate can be a source of technical expertise for outgrowers and can also be the site of ongoing production research.
- The expansion of outgrowers' production can be phased to coincide with expanding processing plant capacity.
There is no standard formula for determining the most appropriate shares of raw material to be provided by the estate and the outgrowers. However, one of the following approaches may be suitable:

- The nucleus estate may be established to meet the needs of a pilot processing facility, with additional needs of later, full-scale operations met by outgrowers while the estate becomes a research and support facility that meets some of its own costs through the sale of services, planting material, and production.
- The nucleus estate may meet the full needs of an initial processing unit, with subsequent expansion being served by an increasing number of outgrowers.
- The nucleus estate may be designed to meet the break-even needs of the processing plant, with a higher degree of capacity utilization being dependent on outgrower supplies.
- The nucleus estate may supply raw material for one production line, with the product, package, or degree of processing becoming diversified as outgrowers become established.

It may be financially appropriate to accept differences in quality between the raw material from the estate and the outgrowers, so that different markets are in effect served by different suppliers, although both use the same processing facility.

Outgrowers in different locations with different climatic and agro-nomic conditions may be contracted to supply raw material at different times than that provided by the nucleus estate, so as to extend the operating period of the processing facility.

**Contract Farming**

While contract farming is the most diverse and complex form of procurement organization, it also offers the greatest potential to satisfy the interests of both producers and processors.

Farming contracts vary widely with respect to their comprehensiveness and the specificity of their terms. At one extreme, a contract may be simply an agreement to buy up to a stated quantity of a particular commodity, as available, at prevailing prices. At the other extreme, it may stipulate variety and quality, include the supply and obligatory use of specific inputs, provide technical assistance and state the husbandry practices to be followed, set precise dates and conditions for delivery, and pro-
vide either a fixed price or a formula for price determination. The means of recovering costs relating to the supply of inputs and services may also be stipulated.

There are two principal factors to consider in determining how specific and how comprehensive a production contract should be: the technical requirements of the raw material, and the degree of difference between the practices needed to meet those requirements and the prevailing production and marketing pattern among suppliers. If the specifications are very demanding and current practices are not technically adequate, the agreement should be developed in detail.

As with all agreements, a production contract can only be effective if three conditions are present: (1) the obligations of both parties must be clearly stated; (2) both parties must possess, or be provided with, the capacity to discharge their obligations; and (3) it must be to the advantage of both parties to adhere to the terms of the agreement.

**POTENTIAL BENEFITS OF CONTRACT FARMING.** The benefits of this form of agricultural production and supply depend on the scope of the contract and its appropriateness to the circumstances of both parties. The potential benefits include the following:

- Producers can reduce their market risk and can therefore make more efficient decisions concerning the use of their productive resources.
- Processors can reduce the uncertainty of raw material supplies and can thereby ensure more efficient capacity utilization.
- Product variability can be reduced, with attendant increases in the unit value of production, reduced culls, and reduced processing costs.
- Postharvest losses can be reduced by eliminating the time element of speculative marketing, and by advanced delivery scheduling.
- Technology can be transferred to producers, some of which will have relevance in other activities of the farm enterprise.
- Contracts may include the provision of capital assets to producers, and these may have residual value or alternative use beyond the scope of the contract.
- Contracts may serve as security for increased access to credit by both producers and processors.
• Contracts may create a greater sense of common interest among producers and induce greater involvement in group activities.
• Contracts draw producers into more frequent contact with the institutional structure of the community, increasing their familiarity and capacity to deal with the formal sector.
• Contract negotiations provide a specific focus for factors such as technical assistance, input supplies, and prices, which influence the well-being of producers and may therefore induce a greater sense of self-determination.

**Problems most frequently encountered in contract farming.** Contracts that fail to reflect the circumstances of the producers and processors or that capitalize on the weak negotiating position of one of the parties are most likely to run into problems. However, even appropriate contracts may be jeopardized by external factors. The following problems are those most frequently encountered:

- Volatility in market prices, or inappropriate price terms in the contract, may lead producers to sell elsewhere or processors to buy elsewhere if prices are more attractive than contract terms.
- Processors may manipulate quality standards so as to reject deliveries or effectively reduce price.
- Producers may revert to traditional market channels to satisfy credit obligations or to secure an essential relationship in the community.
- If the specified production package is not appropriate, poor yields may result in producer dissatisfaction.
- Coordination problems in the timely delivery of inputs to producers or in the provision of services such as mechanical harvesting may prevent producers from realizing the expected benefits of the contract, through no fault of their own.
- Processors or their individual employees may manipulate inputs and services or the assignment of planting or harvesting dates so as to alter production performance or favor selected producers.
- Processors may lack the competence or capacity to deliver the required technical assistance.
- Exogenous variables, particularly the weather, may adversely affect performance and thus discourage further attempts to produce or process the subject commodity.
• Processors may delay payment or otherwise manipulate financial transactions and accounts.
• Contracts may be unnecessarily tied to other agreements such as the sale of inputs or the use of the producers' unrelated production capacity.
• Producers may become tied to a contract relationship by virtue of a debt, specialization, or the disappearance of other markets and may be unable to adjust their production activities to changing conditions.
• The degree to which technology is actually transferred under a contract system can be limited by processor reluctance to provide more than task-level instruction to producers, or by the inability of producers to avail themselves of technology because of educational or financial constraints.

It will be readily apparent from this list that many of the potential problems of contract farming will not arise where goodwill and credibility exist between the parties. It would be unrealistic to assume that these qualities exist between individuals and corporate entities that have no historical relationship on which to base their expectations. These attitudes must be fostered by transparent negotiations and a generous approach to fulfilling obligations in the early stages.

Designing the Contract Farming System

Accurate information concerning raw material requirements and the potential supply area must be available for the design of an appropriate contract farming system. If the commodity or variety of product is new to the area, satisfactory results of agronomic research and local field trials are also prerequisites. With this information in hand, the designer can proceed to (1) determine the components of the system; (2) identify producers; (3) identify intermediaries; (4) determine physical, personnel, and financial needs; (5) determine institutional needs; (6) draw up the contract; and (7) prepare an implementation schedule.

Although these steps are presented here in a sequential fashion, the process should in fact be iterative, with refinements being made to each step on the basis of progressively more detailed discussion among the parties that may ultimately participate in the system. The quality of these discussions will influence the degree of commitment each party feels toward the agreement.
STAGE 1: DETERMINE THE COMPONENTS OF THE SYSTEM. The technological imperatives of the raw material in question and conditions in the supply area may not require a comprehensive contracting and assistance program, but a judgment should be made whether to include each of the following categories:

Quantity to be supplied. In addition to the total quantity to be provided under the contract, consideration should be given to any minimum or maximum quantities, and lot sizes that may be appropriate for individual suppliers.

Quality standards. Each element of the physical or chemical standards must be clearly set out. The enterprise must be able to explain to suppliers or their representatives how each element can be measured and its purpose. The minimum acceptable quality should also be specified, along with the provisions for treating superior and inferior products.

Compensation. A price or price formula must be set for product of the standard quality. Compensation arrangements should include the terms of payment and any adjustment to be made for variation in the quantity or quality of deliveries. If financial assistance (in cash or in kind) is to be provided as part of the agreement, credit terms as well as collection procedures should be specified.

Production assistance. To encourage producers to participate or to ensure quality production, some or all of the following components may be appropriate:

- Inputs: planting materials, fertilizers, and pesticides (feeder stock, feeds, and health supplies)
- Capital items: tools, equipment, on-farm structures
- Custom services: cultivation, pest control, harvesting, (veterinarian services)
- Technical assistance: training, extension services, and technical support for extension workers and producers to address exceptional problems.

Postharvest assistance. To ensure timely deliveries and to maintain product quality, facilities or services may be needed in the following areas:
• Transport: advanced selection of independent truckers, contracts with haulers, or equipment owned by processor or producer organizations
• Storage: on-farm, at assembly points, or plant site
• Grading: equipment, facilities, training, and inspection services
• Packing: materials, equipment, and training.

Intermediation. Intermediaries can enhance efficiency and credibility in the procurement system. They usually participate in input distribution, product assembly and transport, financial services, and producer representation.

Promotion. A promotion program will normally be required, at least in the first several years, to create an awareness of producer opportunities and to provide information concerning the requirements and benefits of participation. Local representatives, field demonstrations, and presentations concerning the overall postharvest operation can help build familiarity and support. The promotion program must avoid creating unrealistic expectations that could leave the participants dissatisfied.

Research and development. Although a locally adapted production package is essential, there should also be some capacity for ongoing research and development, to solve problems arising in the current production package and to develop improved techniques for successive production cycles.

Stage 2: Identify Producers. In identifying the producers who are to participate in the contract system, efficiency should be the first concern. Which producers are likely to perform at the desired level with the least overall cost to themselves and to the enterprise? The operation should begin with these procedures in order to achieve the most positive demonstration effect on other prospective suppliers.

However, participants should not be selected exclusively on the basis of present efficiency. Suppliers from different economic and social groups in the community should be included to reduce the risk of fostering dissent and instability. Furthermore, relative efficiency may be transient; including disadvantaged or inefficient producers in the scheme will establish a basis for the enterprise to influence or benefit from changing economic circumstances.

The following efficiency factors need to be taken into account in selecting producers:
• Capacity: quality of land, and adequacy of facilities, equipment, and labor in the farm enterprise
• Proximity: clustering of prospective suppliers, distance to transport network and processing facility
• Familiarity: similarity of producers’ present farm activities to the proposed production practices
• Responsiveness: enthusiasm for the proposal and some indication of ability to adopt new practices such as education or present level of technology
• Autonomy: legal and financial capacity to make decisions concerning the activities of the farm enterprise
• Cohesion: socioeconomic similarities among prospective suppliers, such as family or ethnic ties, shared facilities or common village, which contribute to strong groups and group reinforcement of individual undertaking

Potential equity issues will become apparent during the survey of the supply area. For example, recent or pending agrarian reform may create a level of enthusiasm among formerly disadvantaged producers who would respond favorably to opportunities to undertake supply activities that complement their pursuit of basic needs.

Landless laborers often account for as much as 50 percent of the population in rural communities. Although these individuals cannot become suppliers in their own right, the development impact of the proposed agroindustry can be greatly enhanced by considering the employment needs of this group in the design of the production package and the selection of producers.

STAGE 3: IDENTIFY INTERMEDIARIES. The use of intermediaries to represent or provide services to those entering a supply contract can often enhance the efficiency of raw material production or build producer commitment to the system. There are several characteristics to look for in intermediaries:

• Capacity (particularly for supply and service intermediaries): capacity and quality of facilities, transport and personnel, organization and management ability, and access to capital
• Proximity (particularly for supply and service intermediaries): location of branches and outlets in relation to producer concentrations and least-cost transport routes
• Familiarity: knowledge of producer and processor constraints; currently engaged in activities similar to those proposed under the procurement system
• Credibility: demonstrated confidence of producers with respect to functions similar to those proposed under the procurement system
• Accessibility: cultural and procedural ease with which producers can deal with the prospective intermediary
• Complementarity: the relationship of the proposed function to other activities, facilities, and responsibilities of the prospective intermediary.

STAGE 4: DETERMINE PHYSICAL, PERSONNEL, AND FINANCIAL NEEDS. Having identified the components and the participants of the procurement system, the next step is to determine the physical, personnel, and financial requirements. For ease of planning, these should be grouped according to the functions they will be performing: input supply, supporting services, production services, postharvest activities, and administration. In addition to listing the types and quantities of the items and expertise required, the analyst should identify their source. This will ensure that the preliminary investigation includes interviews with suppliers to establish their interest and capacity to participate in the system.

It will normally be cost-effective to make use of existing facilities, equipment, and personnel to the extent possible. Such an approach will also minimize the disruption of normal commodity flows and trends and informal relationships in the community.

Technical assistance may be available from the staff of a government or independent agency on a secondment basis. This is feasible where the agricultural activities under the contract system are part of a broader mandate of the specialists' employer. For example, an extension department may agree to the secondment of some of its personnel to provide expertise for a group of producers. Secondment can be beneficial in terms of cost sharing, reduced training needs, and reduced interagency rivalry. Also, in contrast to the general extension agent, the seconded subject matter specialist has a single task to which training, performance, and incentives can be geared.

Budgeting, procurement, and disbursement procedures of organizations participating in the supply of goods and services should be investigated to ensure that they will be able to perform these functions, and to estimate the lead time to be incorporated in the implementation plan.
In costing, allowance should be made for physical and price contingencies. In many cases, the availability, cost, and procedures for acquiring foreign exchange will differ from those pertaining to domestic currency, so local and foreign exchange components of cost should be distinguished.

**Stage 5: Assess Institutional Needs.** Institutional needs consist of two distinct types: those required by the processor and intermediaries to perform their functions, and those required for coordination. Whatever the production system, experience suggests a number of factors need to be considered in determining institutional needs:

- The power and career structures of an entity, whether it is public or private, tend to be reflected in its organization. If a special unit is created to accomplish a new task, the tendency will be for the staff in the unit to become isolated from the decisions and actions of the rest of the organization. Redefining the role of an existing part of the organization is usually to be preferred.
- If a new function must be added to an organization, and a new unit is required, its relationship to the other functions of the organization must be made clear to all managers.
- Performance is greatly affected by the way in which resources and authority are distributed between field offices and headquarters.
- Coordination arrangements should be defined at the planning stage. Individual functions should be designed to allow the maximum degree of independence during execution, to minimize the high cost of field-level coordination. A monitoring system and central reporting point should be established to check implementation progress against an agreed schedule.

**Stage 6: Draw Up the Contract.** A formal contract is simply a means of recording the agreement of each party to accept specified obligations. Having gone through the process outlined in previous paragraphs, planners are in a position to determine what the obligations should be. However, it is not sufficient merely to write those down and call that list a contract. Three additional questions need to be considered: (1) How are written agreements used and perceived in the supply area? (2) How can the terms of the contract be simplified? and (3) What provisions should be made for remedies?
The use and perception of written agreements. In relatively developed communities, producers have frequent dealings with formal institutions, and the level of literacy is high enough that most producers can be expected to understand the content of documents they are considering signing. Where neither of these conditions prevails, or where there has been a history of contract abuse, producers will be suspicious of written documents, which in some cases may even be seen as offensive. Under any of these circumstances, it may be appropriate to rely less on a written agreement than on effective verbal negotiations. Whether in written or oral form, contracts should give equal attention to the obligations of each party.

Simplifying contracts. While it is important for each party to understand its obligations under a contract, these need not be set out in detail in the contract itself. For example, husbandry practices and the use of inputs can be described in a production manual to which reference is made in the contract. The assignment of planting and harvesting dates can also be spelled out separately, although producers must understand how these dates are to be determined. If the contract includes the supply and recovery of credit, its provisions should be stated separately, including the method of price adjustment for delivered goods if that is to be the means of recovery.

Remedies. Oversupply or shortfalls in quantity and quality should be part of the compensation formula. While no agreement can cover all contingencies, a statement of how disputes will be resolved is an important part of the process of fostering mutual confidence. Arbitration by a respected third party can be a useful method of resolving conflict. In the final analysis, the de facto remedies form the basis for attitudes to future contracts, and in most cases it is performance by both parties over a series of contracts that determines the stability of the supply system.

Stage 7: Prepare an implementation schedule. Two aspects of scheduling need to be considered: (1) the growth in coverage of the program toward the levels envisaged for full-scale operations of the processing facility, and (2) the schedule of operations for any one production season.

One of the main reasons that raw material supply tends to be overestimated is that the planners fail to recognize the time required for the supply system to become fully operational. Administrative procedures, particularly within local and host government agencies, can be pro-
tracted; training of successive groups of agents and participants may require weeks or months if implementation problems are to be avoided; and the hiring, purchase or construction of the necessary infrastructure presents its own set of delays. As a result, implementation must take place in phases over several years.

Perhaps the most underestimated factor in implementation projections is the time producers may take to adopt the system. Producers are well aware of the risks of the agricultural environment and are likely to have a cautious approach to change. Most will not risk their well-being on a new enterprise until it has been demonstrated to be superior on the farms of trusted community leaders. The designers of the production system should therefore make sure that they give every opportunity to such leaders to participate at an early stage.

The implementation schedule for any one production season should be developed using a planning tool such as the PERT and Critical Path methods. These techniques are amply explained in other reference materials. However, planners need to take a number of specific steps when scheduling raw material production for an agroindustrial enterprise.

- Always work back from the agricultural calendar, that is, from the time that the inputs or services are required on the farm for optimal production results.
- For administrative and regulatory actions, use time estimates from local experience.
- Identify important dates and budget cycles for participating organizations, and ensure that applications and information will be scheduled for delivery to them in time for orderly consideration. (These dates seldom correspond to the agricultural calendar or to normal supply lead times, but they are nonetheless critical.)
- In estimating procurement and delivery times, cross-check information from suppliers with shipping agencies and the experience of other buyers in the region.
- Make contingency plans for the supply of critical inputs and services, and set dates by which contingency plans will be activated.
- Make sure that those responsible for different parts of the schedule are aware of their roles, and of the interdependence of their actions and those of other participants. Have at least one working session with all participants early in the planning cycle.
• Establish a monitoring system and conduct a review after each season to identify corrective measures for successive production cycles.

Socioeconomic Impact of Raw Material Procurement

The actual impact an agroindustry has on a rural community depends not only on the degree to which performance objectives are realized, but also on how the rural economy adjusts to the presence of this new activity. Even if the enterprise simply buys its raw material through the existing marketing system and does not otherwise affect local production or marketing systems, the additional demand will influence what will be produced, who will do the producing, and what resources will be used. At the margin, these decisions will cause something not to be produced, someone to be excluded from the production process, and some resources to rise or fall in value in relation to others. Such adjustments are the essence of the economic and social impact of establishing an agroindustrial enterprise, to which both the benefit and potential detriment are inexorably linked.

These adjustments are clearly of concern to those charged with planning and directing economic development. However, they are also of direct concern to the proposed enterprise. For any enterprise with fixed assets to depreciate, or with "going concern" value to protect on behalf of its owners, the best decisions are those that optimize results over time. Opportunism is not unknown in agroindustries; some exploit power structures and use inappropriate policy tools to insulate themselves much as other businesses do. But in many cases, problems arise simply because agroindustrial enterprises are unfamiliar with the possible socioeconomic consequences of their activities or do not know how to mitigate adverse effects or enhance positive ones.

It is therefore in the interest of public and private sector participants in development alike to understand the economy in which they propose to intervene, to design raw material procurement systems that will elicit the most favorable response, and to anticipate the adjustment process the community must go through to accommodate the new enterprise. In the course of this investigation, planners and investors will also identify the most effective means of involving producers in the range of decisions that
will affect their own well-being and that of the proposed enterprise. To facilitate this inquiry, the following paragraphs outline the most common elements of change.

**Changes in Production Pattern**

When an agroindustry is introduced, depending on its size, the quantities and types of agricultural commodity produced within the supply radius of the enterprise usually change. The most far-reaching socioeconomic impact occurs when this change is a shift away from food crops that are produced for direct consumption. If the area previously had a surplus in the displaced crop, the impact will be on supply and price elsewhere in the economy; if the area was subsistent in that commodity, local scarcity may develop as households that shifted from food crop production to the cash crop have to enter the market economy to satisfy their food needs. The impact on staple food prices of this adverse shift in both supply and demand can be dramatic.

To assess the impact of inducing greater production of a particular cash crop, the analyst must identify the crops or activities most likely to be displaced and examine the role of those crops or activities in the local economy from the points of view of nutrition, employment, income distribution, and trade relationships. The greatest flexibility in promoting beneficial production of the cash crop in question will occur when one of two sets of conditions prevail: the production region has diversified agricultural activity and widespread trade in surplus production; or underemployed land and labor can be brought into production through technology and incentives without an offsetting reduction in the output of other commodities. Multiple cropping, increased cropping intensity, or diversifying the farm enterprise using underemployed family labor may be effective approaches in the latter case.

In any event, the introduction of a cash crop places an explicit monetary value on one alternative activity of the farm enterprise. Planners must understand the nature of the tradeoffs producers need to consider if the potential benefit of increased income from cash crops is not to be overshadowed by the specter of a food shortage or the underutilization of capacity elsewhere in the economy.
Shifts in Agricultural Employment

Although seasonal underemployment is a typical characteristic of rural economics, the availability of surplus labor cannot be taken for granted. Even the most extensive subsistence production patterns exhibit seasonal peaks in labor requirements that result in full employment for brief periods at critical stages in the production cycle. In developing communities, compensation may be in the form of the exchange of goods or services, but there is a labor market. Effective wage rates vary with season, and the pattern of off-farm employment has evolved to accommodate the seasonal demands of planting and harvest. The introduction of a new cash crop market will alter this employment pattern.

In most cases, the overall demand for labor will increase, leading to upward pressure on wage rates. If the new production activity is complementary in season to traditional production, it will extend the period of agricultural employment. Beyond raising production costs above those that prevailed before the project, these developments make agriculture more dependent on hired labor. They may attract labor from outside the community, and thereby push up the demand for housing, services, and social integration. The individual farmer may become an employer and thus have to acquire a new type of management skill.

Marginal producers may choose or be forced to become employees, relinquishing their role in production decisions and facilitating a concentration of control over land. Although agricultural workers are normally relatively unskilled, related functions in marketing, transport, storage, and processing will reward the development of specific skills. Workers who acquire these skills become dependent on the continued demand for their services, and underemployment among semiskilled and skilled workers is a serious problem in areas where agroindustrial initiatives have not been sustained.

Producers may also contend with increased labor needs by shifting to labor-saving technology. While mechanization may be an efficient alternative, adverse effects can develop as a result of an increased debt burden, changes in the source and terms of borrowed funds, underutilization of equipment, and dependence on parts and service infrastructure. Specific forms of mechanization, typically for land preparation and harvesting equipment, have been found to resolve seasonal labor shortages without contributing to unemployment. However, a general increase in mechanization, instigated by a particular type of shortage and com-
pounded by inappropriate policies such as subsidized credit or uneconomic labor legislation, may lead to capital-intensive production and the displacement of labor that could have been productively employed in agriculture.

A procurement system that anticipates the effects of raw material production on labor demand can promote production packages and influence investment decisions that maintain the most productive use of labor in agriculture. Anticipating changes in the agriculture labor profile will also enable corporate and public sector planners to identify sources of workers for employment elsewhere in the community and their training needs.

**Development of Land Markets**

The existence of a market for agricultural production is the basis of commercial land valuation. As the production pattern shifts from subsistence to marketable surplus and the production of cash crops, the commercial value of farmland increases, values become more transparent (i.e., generally recognized), and the value of any particular parcel depends on its productivity in respect of the marketed commodity. The idea of land as only a home and means of subsistence is replaced by the recognition of land as a salable asset.

When coupled with developments in the labor market and pressures toward an unfamiliar set of production decisions, the existence of a market for land (whether for sale or lease) often creates an irresistible pressure for growers to cash in on their good fortune. The results may be positive in that those entering and continuing in production may be more adept in the new production and market systems, but such a trend can destabilize the rural community. In addition, the need or desire for immediate purchasing power can lead to the decision to sell land without adequate thought to future income prospects. At best, a period of training and transition is required for agriculturalists to become productive elsewhere in the economy.

Land sale under these conditions also tends to result in a concentration of ownership and to keep an increasing share of the population from participating in decisions concerning the use of land. With a change in the ownership or control of land, tenants may be evicted or forced to accept arrangements that are impossible for them to meet, unless their employment is included in the land-use plans of the new owners. Finally,
the proceeds of land sales often are not used to create other productive assets in the community, and consequently employment must be sought elsewhere.

**Increased Market Dependence**

To the extent that cash crop production reduces staple food production, farm families must turn to the marketplace to purchase their subsistence needs. The changing patterns of employment and land ownership also reduce self-sufficiency in other basic needs and create a demand for additional services. Wage-based labor must purchase accommodation, transportation, and personal services to a much greater extent than self-employed agriculturalists.

**Increased Need for Infrastructure and Financial Services**

The logistical needs of market-based agriculture are much greater than those of subsistence-oriented production. In the case of production itself, provision must be made for input distribution and marketing facilities, equipment and spares supply and services, and the regular dissemination of information through efficient means of communication. The increased share of wage earners in the population increases the need for mobility and requirements in transportation and social infrastructure such as housing, public utilities, and training facilities. The greater use of capital inputs and the sale of farm production increase financial transactions and create a need for savings and credit facilities and a payment mechanism.

**Changes in Trade Relationships**

The structure of the traditional rural community is based on stable, multipurpose socioeconomic relationships. One fundamental problem of many land reform programs is that they have disrupted landlord-tenant relationships and failed to introduce substitute sources of goods and services for emancipated tenants. A similar problem often occurs when production and marketing patterns shift to supply a new agroindustrial customer.
Changes in Social Structure

In the absence of formal insurance and welfare systems, the members of traditional rural societies depend on each other for protection against adversity. The time and expense devoted to maintaining one's good standing in the community, such as generous hospitality during festivals, are, in this context, insurance premiums. Hierarchy evolves in relation to the ability to influence the well-being of others and in relation to a sense of identity and value. Changes in production and employment patterns result in changes in dependency, and members of the society will resist these changes to avoid either the loss of power or the loss of security.

With the decision to sell his produce or labor to an entity outside the traditional economy, the individual relinquishes much of his claim to the support and protection of that traditional structure. The extent to which new relationships can meet social as well as economic needs will determine the ease with which this destabilizing process can be withstood. A procurement system that simply purchases produce leaves to chance the outcome of this basic adjustment.
Financial Analysis of Agroindustrial Investments

The methodology used in the financial analysis of agroindustrial enterprises is similar to that applied to any commercial enterprise. The criteria that guide investment and management decisions are also similar. However, different norms exist for many of the ratios and other elements of the financial picture, and financial performance depends on different factors. This chapter deals with the financial interpretation of the unique traits of agroindustrial enterprises.

Three basic financial statements are used in business to track performance and assess financial soundness. These statements are projected into the future when one is assessing the financial prospects of existing enterprises or the soundness of proposed projects.

*Profit and loss statement (income statement).* The profitability of an enterprise is the basic measure of its long-term sustainability.

*Statement of changes in financial position (cash-flow statement).* This statement is particularly important in the early years to determine cash requirements. It also facilitates the discounting of cash flows to determine the internal rate of return and net present value.

*Balance sheet.* This statement presents the assets of the enterprise and how they were funded. It indicates the equity position of the enterprise in relation to debt and so is the basis of measures of financial risk-bearing ability.
Not all decisionmakers are familiar with these statements or know how to interpret them to assess the financial condition and prospects of an enterprise. Since such interpretation is a fundamental aspect of financial analysis, Appendix 1 presents a brief explanation of how to construct and interpret basic financial statements. Statements used in the present discussion are constructed in the appendix.

Characteristics of Agroindustrial Enterprises That Affect Financial Requirements

Despite their diversity, agroindustrial activities share a number of characteristics that have a significant effect on financial performance and on the financial structure needed for viability. The impact of these characteristics must be taken into account when considering the adequacy of the values that emerge from the financial analysis.

Long-Term Market Cycles

All industries face multiyear business cycles and periodic market adjustments driven by changes in technology and consumer preferences. In addition, agroindustries operate in the context of long-term commodity market cycles that are related to the lead time required to change the biological production capacity of the industry.

Tree crops, such as citrus or oil palm, are classic examples of this phenomenon. High prices today may induce many producers to plant new trees, but these trees may take 5-10 years to reach full production. Having incurred the cost of land development and planting, producers are generally committed to await production, irrespective of interim market signals. When the production from the newly planted area finally enters the market, total supply will be a response to historical demand levels, rather than current levels. If there has been a softening of prices in the interim, the incremental supply will drive prices down further, to the point where some producers can no longer afford to stay in production. With the glut thus eased, prices can rise and profitability will return for those who were able to stay in business through the period of losses. Of course, these higher prices start a new round of delayed supply increases, and the cycle repeats itself. Some of these cycles are more or less predictable, especially for major products that are traded widely on world markets (e.g., oil crops, maize, rice, wheat, coffee, cocoa, cotton, beef).
Two implications of such long-term cycles are relevant to the financial analysis of a proposed agroindustrial enterprise. The first is the question of timing. When the project comes on stream, will it be selling into a cyclically high or low price market, and should the investment be accelerated or delayed to adjust start-up timing accordingly? The more fundamental question is whether the enterprise will have adequate flexibility and financial reserves to reduce costs or absorb losses in order to survive cyclical price troughs.

*Seasonal Market Cycles*

Most agroindustrial products have distinct seasonal cycles in the marketplace. On the supply side, prices are usually lowest during and just following the harvest period. The demand for some products is closely associated with festive or religious anniversaries. Within established domestic markets, traditional seasonal consumption patterns have generally evolved to match product availability.

If the enterprise is proposing to store or preserve a traditionally seasonal product so that it can be made available to domestic consumers over a longer period of the year, it needs to conduct a careful market analysis to determine the extent to which these traditional consumption patterns can be changed. Is there really a market outside the traditional consumption season? The situation may be quite different if the product is being aimed at export markets. Climate differences may mean that local harvest time corresponds to shortages in the export market, creating a window of opportunity. Obvious examples are fresh fruit and vegetable exports from the southern hemisphere to the northern hemisphere.

The objective of some agroindustrial enterprises may be to buy raw material when it is available at its lowest seasonal cost and then hold the output until it can be sold at seasonal price peaks. A large investment in storage facilities is needed for this strategy, as well as operating capital to buy and carry inventory from harvest to marketing time. In other cases, there may be no choice but to sell the product into seasonally glutted markets. Under these circumstances, margins are very small, and it is critical for the enterprise to have a financial cushion—from earlier operations or other sources—on which to depend when prices fall below the average or trend levels on which the financial evaluation was based, and raw material costs cannot be reduced proportionately.
Short Harvest and Processing Season

Most agricultural crops have distinct annual harvest periods of short duration. A processing plant may need to have sufficient capacity to handle the whole year's crop in perhaps four to eight weeks, and most agroindustrial plants are very specialized and cannot be used for other purposes during nonharvest periods of the year. As a result, the factory may sit idle for most of the year, and the fixed costs per unit of throughput will be correspondingly higher. The solution usually lies in extending the harvest period with agronomic changes, and extending the processing period by performing similar operations on a number of different raw materials.

It is this contrast between the fixed cost of its investment and the highly cyclical pattern of its raw material supply that presents perhaps the greatest financial challenge to an agroindustrial enterprise. This pattern demands conservative financial projections and reserves or credit facilities that will accommodate operating deficits for several months at a time.

Raw Material Usually Perishable

The perishable nature of most agricultural products exacerbates the problem of the short harvest season. Either processing capacity must be adequate to keep up with the intake, or expensive storage facilities must be built to preserve the quality of the raw material. This again adds to fixed costs. In addition, spare parts inventories and qualified maintenance and repair personnel must be kept on site to minimize downtime during the processing period, with the result that working capital costs will also be high.

Raw Material Variable in Quality

The variability in quality of agricultural produce adds another dimension of uncertainty and management challenge to the agroindustrial enterprise. Not only must the quality of the finished product be consistent in order to secure and retain markets, but in keeping to this standard the enterprise eliminates a share of raw material from use in that final product. To control the effective cost of raw material for its primary product, the enterprise must find markets for these different qualities.
Consistent with the market-driven approach that is necessary for success, managers must think of costs and revenue per unit of marketable finished product. "Recovery rate," that is, the amount of final product per unit of raw product intake (usually expressed as a percentage)—is one of the basic measures of performance in any agroindustrial enterprise. Suppliers of raw products should be thoroughly briefed on the importance and means of maintaining produce quality, reinforced by appropriate financial incentives and penalties. If the producer can be induced to undertake effective quality screening before delivering to the plant, plant operating costs are reduced, as are fixed costs because the size and cost of plant per unit of finished product can be reduced.

Degrees of Processing

One economic development strategy is to move to successive stages of processing so as to increase employment and capture a larger share of value added in the finished product. Political considerations tend to push projects beyond the stage of processing at which they are financially viable and economically beneficial. With greater degrees of processing, the cost advantages of raw material become less significant in the competitiveness of the finished product price in the marketplace. Every further processing step requires more scarce capital, often in the form of foreign exchange, and more management skills in all areas of production, marketing, and finance (see Chapter 3).

Wide Range of Processing Technologies and Scale of Plant

The technological alternatives available to process many agricultural products range from labor-intensive cottage industry methods to the sophisticated capital-intensive equipment and operations normally associated with large modern plants.

Advanced technology and larger-capacity plants can reduce variable costs such as labor per unit of throughput, and they may strengthen the enterprise's position in the marketplace because of higher and more consistent quality standards and volumes that attract the interest of large buyers. At the same time, the size and level of their technology will place demands on infrastructure, management, and skilled labor. Because of high fixed costs, such plants must be operated near their effective capac-
ity to be viable and must also be assured of adequate supplies and markets.

Steps in the Financial Analysis of Agroindustrial Enterprises

As with other aspects of the design and evaluation of a project, tentative conclusions at any stage in the financial analysis may need to be revised on the basis of the results of the work in succeeding stages. Nevertheless, certain steps must be followed in a particular sequence in analyzing agroindustrial proposals.

1. Determine probable revenue pattern. Estimate volumes and prices for each product and market, including ranges and variability (see Chapter 2).

2. Prepare preliminary estimates of investment and operating costs. Base these estimates on alternative processing technologies and equipment identified as a result of investigations such as those described in Chapter 3.

3. Determine the supply potential of raw material. Establish the probable range of delivered prices that the agroindustrial enterprise will have to pay for its raw material (see Chapter 4).

4. Conduct a preliminary assessment of financial feasibility. Estimates and trade norms form an adequate basis for this early test of the two or three sizes and levels of technology that can service the supply and demand volumes identified in the earlier steps. For this stage, use indicative investment and operating costs from studies of similar operations, adjusted to the circumstances of the particular proposal being analyzed.

5. Conduct a complete financial analysis of the most attractive alternatives. The complete financial analysis requires detailed estimates of operating and investment costs, plus a refinement of market and raw material supply figures. These data are then projected over a suitable period—five years or the economic life of the proposed investment is common—in the form of pro forma financial statements: profit and loss (P&L), changes in financial position (cash flow), and balance sheet. Ratio analysis and the determination of internal rate of return are the principal analytical techniques.

6. Conduct a sensitivity analysis. Identify key variables in the financial
performance of the proposed enterprise, and test the impact of a range of alternative values for these variables. Use the results to flag serious risk factors.

7. Compare the analytical results with investment criteria. Best-estimate values for important ratios and internal rate of return are compared with values set by the sponsors for investment decision purposes. Values from sensitivity analysis are compared with the sponsors’ tolerance for risk.

8. Identify the conditions under which the proposed enterprise meets the investment criteria. Most conditions will relate to organizational, financial, and managerial aspects of the enterprise. The most important of these is management.

In this chapter, we assume that Steps 1, 2, and 3 have already been taken. We begin with Step 4, a preliminary assessment of financial feasibility using a set of revenue, cost, technology, and supply assumptions from the earlier steps.

Appropriate Size and Level of Technology

A full financial feasibility study is a time-consuming and expensive exercise, so it is usually carried out for just one size and technology rather than for the complete range of possible scales of operations and possible types of technology that can be used. Size and technology choices tend to be based on a number of factors that give insufficient weight to financial and economic viability.

Planners and political decisionmakers tend to favor larger and more sophisticated operations for several reasons: the high visibility and glamour of large high-technology projects, the large number of farmers and employees that could benefit from operations at capacity, the new skills that "will be developed" to operate and maintain the enterprise, the type of equipment and technology that a bilateral (or even multilateral) donor or lender would like to put in place, and the preference of donors and lenders for larger projects because their own project design and management costs are thus a lower percentage of the project funds involved.

Investors are also drawn toward such projects, first, because of the "use it or lose it" view of the recipients of credit or equity funds. Experience gives some credibility to the fear that investors are likely to lose this
money if they do not put it into the large sophisticated enterprise while
they can. Sponsors could start at a manageable level now to build a solid
base of supply, markets, skills, and financial strength. But they fear that
when they are actually ready to move to the larger and more sophisti-
cated operation, they may not have access to funding. Two other reasons
for this bias are overoptimism concerning either the rate of market pene-
tration or the rate of raw material supply buildup, and a lack of apprecia-
tion for the difficulties in transferring technology from one setting to
another.

In view of this bias toward large and modern operations and the time
and cost involved in preparing full feasibility studies, a complete finan-
cial analysis is usually done on just the larger-scale and higher-technol-
ogy projects. The result may be positive, using realistic forecasts of
markets, supply, operating coefficients, and management skills. However,
the project may also appear feasible only because optimistic assumptions
were made for market penetration, management skills, or some other crit-
ical factor.

To increase the probability that the best size and technology will be
selected, preliminary screening should be done on a wider range of possi-
bilities, using traditional and simple rules of thumb as criteria. Then the
full financial analysis can be done on the size and technology that looks
most promising on the basis of these simple criteria.

Tables 5.1—5.12 show how a preliminary assessment can be prepared
for three plant sizes incorporating higher levels of technology in succes-
vively larger plants. The “medium” plant represents the same one used in
the appendix to illustrate financial statements.

Plant Parameters and Financing

When volumes and prices have been determined by the raw material
supply and market demand studies, the next (or concurrent) step in the
financial analysis is to estimate investment and operating costs at realistic
levels of capacity utilization for two or three sizes and technology levels
for the plant. Include assumptions about how these plants would be
financed.

Here are some tips on preparing estimates of initial parameters:

- Use no more than 80 percent of the rated plant capacity as a realis-
tic estimate of sustainable volumes.
<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Plant Size and Technology</th>
<th>Unit</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant parameters</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated capacity</td>
<td>Tons/year</td>
<td>3,000</td>
<td>5,000</td>
<td>10,000</td>
<td></td>
</tr>
<tr>
<td>Real capacity (80% rated capacity)</td>
<td></td>
<td>2,400</td>
<td>4,000</td>
<td>8,000</td>
<td></td>
</tr>
<tr>
<td>Capital cost of fixed assets</td>
<td></td>
<td>300,000</td>
<td>1,000,000</td>
<td>2,000,000</td>
<td></td>
</tr>
<tr>
<td>Economic life of fixed assets</td>
<td>Years</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>Average/year</td>
<td>15,000</td>
<td>50,000</td>
<td>100,000</td>
<td></td>
</tr>
<tr>
<td>Initial financing</td>
<td>Cash equity for operating</td>
<td>30,000</td>
<td>100,000</td>
<td>200,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cash equity for fixed assets (20% of cost)</td>
<td>60,000</td>
<td>200,000</td>
<td>400,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total beginning equity</td>
<td>90,000</td>
<td>300,000</td>
<td>600,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Term loan financing</td>
<td>240,000</td>
<td>800,000</td>
<td>1,600,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interest rate on term loan (%)</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interest on term loan</td>
<td>First year</td>
<td>28,800</td>
<td>96,000</td>
<td>192,000</td>
</tr>
</tbody>
</table>
Use a rough estimate of the total initial capital outlay required for each plant size. At this preliminary stage, approximations from equipment suppliers and local construction contractors or engineers may be sufficiently accurate.

Available equity is the basic constraint on the size of investment. The amount of equity available determines how much debt can be assumed, and equity plus debt is the maximum investment. Remember, too, that a portion of this equity and debt will be needed for initial operating costs.

Here are some tips on preparing estimates of operating costs.

- Higher technology plants may be expected to have higher recovery rates and thus to deliver more finished product per ton of raw material, as assumed in this example.
- Labor, energy, packaging, and shipping will be among the main direct or variable costs.
- The extent to which labor laws and customs allow the labor force to adjust to changing volumes may affect how much of the labor costs are truly variable.

### Table 5.2 Operating Costs and Margin per Unit
(U.S. dollars)

<table>
<thead>
<tr>
<th>Margin/Coefficient</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw material cost coefficients</td>
<td>70</td>
<td>80</td>
<td>85</td>
</tr>
<tr>
<td>Recovery rate (%)&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buying price /ton raw product</td>
<td>70</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>Selling price/ton</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Raw product cost/ton sold</td>
<td>100</td>
<td>88</td>
<td>82</td>
</tr>
<tr>
<td>Other direct costs/ton sold</td>
<td>100</td>
<td>75</td>
<td>65</td>
</tr>
<tr>
<td>Direct cost of sales/ton sold</td>
<td>200</td>
<td>163</td>
<td>147</td>
</tr>
<tr>
<td>Contribution margin/ton sold</td>
<td>100</td>
<td>138</td>
<td>153</td>
</tr>
</tbody>
</table>

<sup>a</sup> Finished product as a percentage of raw product intake.
Table 5.3 General Expenses or Fixed Costs
(U.S. dollars)

<table>
<thead>
<tr>
<th>Item</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed costs per year</td>
<td>160,000</td>
<td>294,000</td>
<td>450,000</td>
</tr>
<tr>
<td>General overhead expenses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest on term loan, 1st year</td>
<td>28,800</td>
<td>96,000</td>
<td>192,000</td>
</tr>
<tr>
<td>Depreciation (average per year)</td>
<td>15,000</td>
<td>50,000</td>
<td>100,000</td>
</tr>
<tr>
<td>Fixed costs</td>
<td>203,800</td>
<td>440,000</td>
<td>742,000</td>
</tr>
</tbody>
</table>

Here are some tips on preparing estimates of fixed charges:

- Standard overhead items such as management and other "permanent" employees, insurance, office expenses, and the like are included under general overhead expenses.
- First-year interest should be used for term loans rather than average annual interest, to provide an extra margin of safety in the analysis of the early, high-risk years.

Coefficients of Possible Plants

Table 5.4 presents the main coefficients of each plant for easy reference. The only additional information needed is the average tax rate, which will be used to calculate after-tax returns. If there is a graduated tax rate that would bear more heavily on the larger-volume plants operating at capacity, the tax rate used should reflect that difference. Everything needed for a typical estimate of profit and loss statement is now available, so comparative P&L statements can be presented (Table 5.5).
<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Unit</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plant parameters</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated capacity</td>
<td>Tons/year</td>
<td>3,000</td>
<td>5,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Real capacity (80% of rated capacity)</td>
<td>Tons/year</td>
<td>2,400</td>
<td>4,000</td>
<td>8,000</td>
</tr>
<tr>
<td>Capital cost of fixed assets</td>
<td>US$</td>
<td>300,000</td>
<td>1,000,000</td>
<td>2,000,000</td>
</tr>
<tr>
<td>Economic life of fixed assets</td>
<td>years</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Depreciation (average per year)</td>
<td>US$</td>
<td>15,000</td>
<td>50,000</td>
<td>100,000</td>
</tr>
<tr>
<td><strong>Initial financing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash equity for operating, etc.</td>
<td>US$</td>
<td>30,000</td>
<td>100,000</td>
<td>200,000</td>
</tr>
<tr>
<td>Cash equity for fixed assets (20% of cost)</td>
<td>US$</td>
<td>60,000</td>
<td>200,000</td>
<td>400,000</td>
</tr>
<tr>
<td>Total beginning equity</td>
<td>US$</td>
<td>90,000</td>
<td>300,000</td>
<td>600,000</td>
</tr>
<tr>
<td>Term loan financing</td>
<td>US$</td>
<td>240,000</td>
<td>800,000</td>
<td>1,600,000</td>
</tr>
<tr>
<td>Interest rate on term loan</td>
<td>Percent</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Interest on term loan, first year</td>
<td>US$</td>
<td>28,000</td>
<td>96,000</td>
<td>192,000</td>
</tr>
<tr>
<td><strong>Raw material cost coefficients</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;Recovery rate&quot; (Finished product as percentage of raw product intake)</td>
<td>Percent</td>
<td>70</td>
<td>80</td>
<td>85</td>
</tr>
<tr>
<td>Buying price for raw product</td>
<td>US$/ton</td>
<td>70</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>Raw product cost/ton sold</td>
<td>US$/ton</td>
<td>100</td>
<td>88</td>
<td>82</td>
</tr>
<tr>
<td><strong>Revenues and direct costs per ton</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Selling price</td>
<td>US$/ton</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Raw product cost</td>
<td>US$/ton</td>
<td>100</td>
<td>88</td>
<td>82</td>
</tr>
<tr>
<td>Other direct costs</td>
<td>US$/ton</td>
<td>100</td>
<td>75</td>
<td>65</td>
</tr>
<tr>
<td>Direct cost of sales</td>
<td>US$/ton</td>
<td>200</td>
<td>163</td>
<td>147</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>US$/ton</td>
<td>100</td>
<td>138</td>
<td>153</td>
</tr>
<tr>
<td><strong>Fixed costs per year</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General overhead expenses</td>
<td>US$</td>
<td>160,000</td>
<td>294,000</td>
<td>450,000</td>
</tr>
<tr>
<td>Interest on term loan, 1st year</td>
<td>US$</td>
<td>28,800</td>
<td>96,000</td>
<td>192,000</td>
</tr>
<tr>
<td>Depreciation (average per year)</td>
<td>US$</td>
<td>15,000</td>
<td>50,000</td>
<td>100,000</td>
</tr>
<tr>
<td>Fixed costs</td>
<td>US$</td>
<td>203,800</td>
<td>440,000</td>
<td>742,000</td>
</tr>
<tr>
<td>Average income tax rate</td>
<td>Percent</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>
Table 5.5 Profit (Loss) Per Year Operating at Real Capacity (U.S. dollars)

<table>
<thead>
<tr>
<th>Plant Size and Technology</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sales volume</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tons/year</td>
<td>2,400</td>
<td>4,000</td>
<td>8,000</td>
</tr>
<tr>
<td><strong>Sales</strong></td>
<td>US$</td>
<td>US$</td>
<td>US$</td>
</tr>
<tr>
<td></td>
<td>720,000</td>
<td>1,200,000</td>
<td>2,400,000</td>
</tr>
<tr>
<td><strong>Direct cost of sales</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raw product cost</td>
<td>US$</td>
<td>US$</td>
<td>US$</td>
</tr>
<tr>
<td></td>
<td>240,000</td>
<td>350,000</td>
<td>658,824</td>
</tr>
<tr>
<td>Other direct costs</td>
<td>US$</td>
<td>US$</td>
<td>US$</td>
</tr>
<tr>
<td></td>
<td>240,000</td>
<td>300,000</td>
<td>520,000</td>
</tr>
<tr>
<td>Direct cost of sales</td>
<td>US$</td>
<td>US$</td>
<td>US$</td>
</tr>
<tr>
<td></td>
<td>480,000</td>
<td>650,000</td>
<td>1,178,824</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>US$</td>
<td>US$</td>
<td>US$</td>
</tr>
<tr>
<td></td>
<td>240,000</td>
<td>350,000</td>
<td>1,221,170</td>
</tr>
<tr>
<td><strong>Fixed costs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General overhead</td>
<td>US$</td>
<td>US$</td>
<td>US$</td>
</tr>
<tr>
<td></td>
<td>160,000</td>
<td>294,000</td>
<td>450,000</td>
</tr>
<tr>
<td>Interest on fixed asset</td>
<td>US$</td>
<td>US$</td>
<td>US$</td>
</tr>
<tr>
<td>term loan</td>
<td>28,800</td>
<td>96,000</td>
<td>192,000</td>
</tr>
<tr>
<td>Depreciation</td>
<td>US$</td>
<td>US$</td>
<td>US$</td>
</tr>
<tr>
<td></td>
<td>15,000</td>
<td>50,000</td>
<td>100,000</td>
</tr>
<tr>
<td>Fixed costs</td>
<td>US$</td>
<td>US$</td>
<td>US$</td>
</tr>
<tr>
<td></td>
<td>203,800</td>
<td>440,000</td>
<td>742,000</td>
</tr>
<tr>
<td>Profit (loss) before tax</td>
<td>US$</td>
<td>US$</td>
<td>US$</td>
</tr>
<tr>
<td></td>
<td>36,200</td>
<td>110,000</td>
<td>479,176</td>
</tr>
<tr>
<td>Income tax</td>
<td>US$</td>
<td>US$</td>
<td>US$</td>
</tr>
<tr>
<td></td>
<td>7,240</td>
<td>22,000</td>
<td>95,835</td>
</tr>
<tr>
<td>Profit (loss) after tax</td>
<td>US$</td>
<td>US$</td>
<td>US$</td>
</tr>
<tr>
<td></td>
<td>28,960</td>
<td>88,000</td>
<td>383,341</td>
</tr>
</tbody>
</table>

Contribution Margin versus Gross Profit

Readers familiar with the terms "gross profit" or "gross profit margin" should note that they are not synonymous with contribution margin, as defined here. To calculate gross profit, the cost of sales must include fixed manufacturing costs. This absorption costing approach results in a more complete distribution of manufacturing costs among products, and is therefore more useful as a cost control tool. However, the investment analyst is generally more concerned with the distinction between fixed and variable costs and will use the direct cost method and contribution margin.
A simple comparison of net income among these three plants suggests that the largest and most sophisticated is the obvious choice if a volume of 8,000 tons can be sold. Two plants of the "medium" capacity could satisfy the same market, but the profit under that alternative would be less than half that of the one large plant ($88,000 \times 2 = $176,000). The same argument would be made between two "small" plants and one "medium" plant if about 4,000 tons were the expected volume.

However, the choice is not as simple as implied in the preceding paragraph. In particular, the degree of confidence in reaching target volumes and the speed with which these target volumes can be reached are crucial considerations in the choice of plant. The following section discusses how the analyst can use traditional rule-of-thumb investment criteria to decide whether to proceed and which plant size and technology to look at in detail.

**Preliminary Assessment of Financial Feasibility**

Having constructed typical P&L statements for operations at full capacity for each of three possible plants, the analyst can apply several simple rules of thumb to determine which, if any, of the alternatives is promising enough to justify conducting a full financial analysis. However, it is first necessary to establish which supply and market constraints will limit the realistic range of alternatives.

**Establishing Supply and Market Constraints**

The most important background information at this stage is the probable market volume over time and the probable supply of raw material over time. These constraints must be identified before proceeding with the analysis. Although the potential of a processing facility is best measured at or near its productive capacity, in reality plants cannot always operate at that level, and their actual performance will be poorer at lower levels.

On the market side, let us assume that the investigation found two buyers representing a combined immediate market for 2,000 tons for a product of good consistent quality, and that the consensus of all buyers was that as much as 5,000 to 6,000 tons would be reached five years from now, followed by further gradual increases.

On the raw material supply side, we can assume that few farmers will be willing to produce the raw material an enterprise needs without a
guaranteed market. Let us assume that, even with a purchase guarantee, the likely maximum supply in the first year would be 2,000 tons of raw material. The maximum second-year crop would be 3,000 tons, with the increases coming primarily from higher yields and increases in area among first-year growers, plus a few new growers. From the third year on, after doubts have been removed about how to grow the crop and whether or not it is profitable, there would be no problem increasing raw material supply by 3,000 tons every year for at least five years. These findings are summarized below.

### Summary of Supply and Market Assumptions

<table>
<thead>
<tr>
<th>Year</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum probable supply of raw material/tons</td>
<td>2,000</td>
<td>3,000</td>
<td>6,000</td>
<td>9,000</td>
<td>12,000</td>
</tr>
<tr>
<td>Maximum probable purchases of finished product/tons</td>
<td>2,000</td>
<td>2,500</td>
<td>3,000</td>
<td>4,000</td>
<td>5,000</td>
</tr>
</tbody>
</table>

### Using Industry Coefficients as Guides

Industry coefficients, or averages, are most useful at the early stages of the investment analysis, when preliminary screening is being done. Of course, the danger of using coefficients from elsewhere is that they may not be relevant to the particular circumstances of the proposed investment. The analyst can select correctly from among alternative coefficients or improve the usefulness of a coefficient by looking at the underlying elements that determine relevance.

**Timeliness.** If norms are out of date, solicit new information from suppliers, processors, trade associations, or government agencies.

**Location.** They may refer to another country or region, in which the infrastructure, policy environment, cost structure, and availability of skilled labor, management, and foreign exchange are immensely different.
 SIZE. Coefficients concerning investment and operating costs per unit of throughput tend to be specific to size of operations.

 TECHNOLOGY. Differences in this respect can mean virtually different products, as well as different cost and physical coefficients. Recall that conversion rates differ among the plants in our example—1,000 tons of raw material converts to only 700 tons of finished product in the small plant, 800 tons in the medium plant, and 850 tons in the large plant, representing recovery rates of 70 percent small, 80 percent medium, and 85 percent large.

 Credibility of coefficients enters the analysis at a more personal level as well. Even if the enterprise looks feasible using just average performance of similar ventures, will the management of the proposed enterprise be capable of performing to that level? How much related experience does the management team have? How long will it take for it to develop the skills needed in the new business? What management information systems will be in place to forewarn the team of problems and opportunities in time for effective action? Can the organizational structure match authority with responsibility to permit well-informed and rapid response to needs? Remember, the seasons wait for no one.

 If the coefficients are not relevant, the resulting financial analysis will not be credible.

 This section presents six quick measures of viability. First, the supply and market constraints are ignored in order to arrive at a “best case” performance indicator for each measure. Then the supply and market constraints are taken into account to determine if there is scope for the enterprise to operate at the optimal levels.

 Profit (Loss) per Unit of Production

 Profit divided by the number of units of product produced. One of the most commonly used and abused measures of viability is profit per unit (e.g., per ton) of production. The danger of this measure for investment decision purposes is that it tends to be calculated for a volume of operations at or near capacity, whereas, especially in the early years, supply and market constraints do not permit operation at that volume. (For simplicity in this example, let us assume that all production is sold.) As
Table 5.6 Performance by Plant Size

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales at real capacity</td>
<td>Tons/year</td>
<td>2,400</td>
<td>4,000</td>
<td>8,000</td>
</tr>
<tr>
<td>Crop purchased at real capacity</td>
<td>Tons/year</td>
<td>3,429</td>
<td>5,000</td>
<td>9,412</td>
</tr>
<tr>
<td>Volume sold</td>
<td>Tons/year</td>
<td>2,400</td>
<td>4,000</td>
<td>8,000</td>
</tr>
<tr>
<td>Profit (loss) before tax</td>
<td>US$</td>
<td>36,200</td>
<td>110,000</td>
<td>479,176</td>
</tr>
<tr>
<td>Profit (loss)/ton</td>
<td>US$</td>
<td>15</td>
<td>28</td>
<td>60</td>
</tr>
</tbody>
</table>

illustrated in Table 5.6, the calculations at or near capacity almost always favor the large, high-technology plant.

In general, a profit per ton figure is more interesting than useful. It masks the greater financial risks associated with higher fixed costs and debt burden typical of larger scale and higher technology.

In this case, when the raw material supply and market constraints are reintroduced, none of the plants are able to operate at the levels for which the profit figures apply. In the first year, the raw material supply constraint does not permit even the small plant to operate at capacity, and the market constraint indicates that the large plant could not sell its full-capacity output, even in Year 5.

Break-Even Volume and Margin Analysis

Fixed costs divided by contribution margin. Break-even volume is the number of units of sales at which profit is just zero. Further examination is needed to determine how high volume must be to reach acceptable profit levels. But calculating break-even volume is a good start, showing the minimum volumes that must be reached and maintained (Table 5.7). Also, the margin analysis components of the calculation are used in other rule-of-thumb measurements.
Table 5.7 Break-Even Analysis by Plant Size
(U.S. dollars)

<table>
<thead>
<tr>
<th>Item</th>
<th>Units</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales at real capacity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantity</td>
<td>Tons/year</td>
<td>2,400</td>
<td>4,000</td>
<td>8,000</td>
</tr>
<tr>
<td>Value</td>
<td>US$</td>
<td>720,000</td>
<td>1,200,000</td>
<td>2,400,000</td>
</tr>
<tr>
<td>Contribution margin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>US$</td>
<td>240,000</td>
<td>550,000</td>
<td>1,221,176</td>
</tr>
<tr>
<td>Per ton</td>
<td>US$</td>
<td>100</td>
<td>138</td>
<td>153</td>
</tr>
<tr>
<td>Fixed costs</td>
<td>US$</td>
<td>203,800</td>
<td>440,000</td>
<td>742,000</td>
</tr>
<tr>
<td>Break-even volume</td>
<td>Tons/year</td>
<td>2,038</td>
<td>3,188</td>
<td>4,850</td>
</tr>
</tbody>
</table>

In the Summary of Supply and Market Assumptions presented earlier, the market is just about big enough for the small plant to reach its break-even volume of 2,038, even in the first year. However, a raw material supply shortage in the first year (1,400 tons of product at a conversion rate of 70 percent) means that break-even cannot be reached until Year 2, when the 3,000-ton supply allows 2,100 tons of product for the 2,500-ton market. Thereafter, it can easily operate at its 2,400-ton capacity. In fact there is room for two small plants to break even by Year 4 and to operate at capacity by Year 5.

The medium plant is constrained by supply until Year 3 and by the market until Year 4. It operates at only half its 3,200-ton break-even in Year 1, almost reaches break-even in Year 3, and can operate at real capacity by Year 4. If the 5,000-ton market is still there for Year 5, minor plant modifications and expansion then may be able to boost processing capacity enough to fill that market.

The large plant could get enough supply by Year 3 to reach its 4,861-ton break-even (6,000 tons raw convert to 5,100 tons finished product), but it is not until Year 5 that the market will be just barely big enough to take the break-even volume. Can the business survive four or five years of losses? Even if it can, will the market be big enough after that to allow it to recover those losses?
**Payback Period**

The total cost of investment, divided by the sum of profit plus depreciation plus interest on debt used to finance fixed assets. "Payback period" (in years) is a commonly used investment criterion. It is intended to answer the question, "How many years will it take to recover the initial investment?" It is a simple calculation that is an effective means of comparing investments bringing relatively stable earnings from year to year. However, the results can be misleading if earnings are variable, move steadily up or down, or are positive in the long term only after some initial years of operating at a loss. Only the internal rate of return or net present value calculations can take into account all these factors when comparing alternative investments. Payback period is calculated in several ways, but the basic principle is to see how long it will take for some measure of "profit" to equal the original investment. Both depreciation and the cost of capital employed in making the investment are usually ignored when calculating the "profit" resulting from the investment. Table 5.8 shows the result of applying the calculation to our examples.

**Table 5.8 Payback Period by Plant Size**
*(U.S. dollars)*

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales at real capacity, tons/year</td>
<td>Tons/year</td>
<td>2,400</td>
<td>4,000</td>
<td>8,000</td>
</tr>
<tr>
<td>Investment in current assets</td>
<td>US$</td>
<td>30,000</td>
<td>100,000</td>
<td>200,000</td>
</tr>
<tr>
<td>Investment in fixed assets</td>
<td>US$</td>
<td>300,000</td>
<td>1,000,000</td>
<td>2,000,000</td>
</tr>
<tr>
<td>Total investment</td>
<td>US$</td>
<td>330,000</td>
<td>1,100,000</td>
<td>2,200,000</td>
</tr>
<tr>
<td>Profit (loss) before tax (Table 5.5)</td>
<td>US$</td>
<td>36,200</td>
<td>110,000</td>
<td>479,176</td>
</tr>
<tr>
<td>Plus: interest (term loans for fixed assets)</td>
<td>US$</td>
<td>28,800</td>
<td>6,000</td>
<td>192,000</td>
</tr>
<tr>
<td>Plus: depreciation</td>
<td>US$</td>
<td>15,000</td>
<td>50,000</td>
<td>100,000</td>
</tr>
<tr>
<td>&quot;Profit&quot; for payback calculation</td>
<td>US$</td>
<td>80,000</td>
<td>256,000</td>
<td>771,176</td>
</tr>
<tr>
<td>Payback period</td>
<td>Years</td>
<td>4.1</td>
<td>4.3</td>
<td>2.9</td>
</tr>
</tbody>
</table>
Here is the first indication that the small plant may be more attractive financially than previous measures have indicated. Previous measures favored the medium plant, under full capacity conditions, on the basis of profit per ton or total profit, but now it is clear that about 75 days more would be required to recover the cost of investing in the medium plant, at full capacity. Although this is not a considerable difference, it represents a longer period of exposure to political risk, to foreign exchange risk, or to other changes that would alter the attractiveness of continuing in the enterprise. It is only by examining the investment criteria of the owners and the circumstances of the investment that the analyst can establish the relative importance of these measures.

At full capacity, the large plant again looks like the clear winner. The catch, of course, is that the information concerning supply and market constraints indicates that this plant will not even reach break-even volumes until Year 5, and it is not clear when, or even if, volumes beyond that would be sufficient to recover the losses of early years.

Average Return on Investment

The sum of profit plus the interest on term loans used to finance fixed assets, divided by total assets, expressed as a percentage. Average return on investment sounds more sophisticated than payback period but, in fact, it tests essentially the same relationship. It compares some measure of “profit” at a given volume with investment costs.

The reason for adding term loan interest back into profit is that the objective here is to measure the rate of return on the total investment regardless of how it was financed. Interest paid on the loan is an expense that reduces profits, but it is also part of the return on capital that happens to be paid to the outside creditor rather than to the owners of the business. Another way to think of this is the owner asking, “What would be my rate of return if it were just my own money invested in this venture?”

Since average return on investment is essentially another way of measuring the same relationship as payback period, it is not surprising that the conclusion of both measures is similar (Table 5.9).

With the calculations done at plant capacity, the small plant with its slightly higher rate of return is favored over the medium plant. The large
### Table 5.9 Average Return on Investment by Plant Size
(U.S. dollars)

<table>
<thead>
<tr>
<th>Item</th>
<th>Units</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales at real capacity,</td>
<td>Tons/year</td>
<td>2,400</td>
<td>4,000</td>
<td>8,000</td>
</tr>
<tr>
<td>Total investment</td>
<td>US$</td>
<td>330,000</td>
<td>1,100,000</td>
<td>2,200,000</td>
</tr>
<tr>
<td>Profit (loss) before tax</td>
<td>US$</td>
<td>36,200</td>
<td>110,000</td>
<td>479,176</td>
</tr>
<tr>
<td>Plus: interest on fixed asset loan</td>
<td>US$</td>
<td>28,800</td>
<td>96,000</td>
<td>192,000</td>
</tr>
<tr>
<td>Return on total investment</td>
<td>US$</td>
<td>65,000</td>
<td>206,000</td>
<td>671,176</td>
</tr>
<tr>
<td>Percentage return on total investment</td>
<td>Percent</td>
<td>20</td>
<td>19</td>
<td>31</td>
</tr>
</tbody>
</table>

Plant shows the most favorable return, but it is not realistic to expect this volume until perhaps many years after the first investment has been made. The real situation is that the accumulated losses of the early years would represent a significantly larger investment against which the same income stream would have to be compared. Factoring these supply and market constraints into the equation would result in a much lower rate of return.

### Average Return on Equity

Profit, divided by equity, expressed as a percentage. Average return on equity is closely related to average return on investment. The difference is that it answers the owner's question, "After covering all costs, including the interest paid to lenders as their return on capital, what rate of return would I receive on my own funds invested in the project?" The calculation is again based on some given annual volume.

The effect of "leverage" or "gearing"—that is, using someone else's capital to increase the returns to one's own capital—can be seen in Table 5.10. When the return on total investment is higher than the rate of interest paid on borrowed money (12 percent in our example), amounts over the borrowing rate accrue to the owner. This excess is therefore additional return to the owner's own equity investment. In the medium plant example, there was a 19 percent return on total investment. That means the owner received a 19 percent return on his own equity of $300,000 (actually 18.73 percent, so about $56,200 return to owner), plus 7 percent (19 percent minus 12 percent paid to lender) on the $800,000 borrowed funds.
Table 5.10 Average Return on Equity by Size of Plant  
(U.S. dollars)

<table>
<thead>
<tr>
<th>Item</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales at real capacity, tons/year</td>
<td>2,400</td>
<td>4,000</td>
<td>8,000</td>
</tr>
<tr>
<td>Return on equity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total beginning equity</td>
<td>90,000</td>
<td>300,000</td>
<td>600,000</td>
</tr>
<tr>
<td>Profit (loss) before tax</td>
<td>36,200</td>
<td>110,000</td>
<td>479,176</td>
</tr>
<tr>
<td>Percentage return on equity</td>
<td>40</td>
<td>37</td>
<td>80</td>
</tr>
</tbody>
</table>

(about $53,800 return to owner). The total return of $110,000 to the owner is equivalent to 37 percent of his equity investment.

But leverage also works the other way and can have a serious impact when the average return on total investment is lower than the borrowing rate. Assume for a moment that the average return on total investment had been 10 percent (i.e., $110,000). The 12 percent interest on the $800,000 term loan (i.e., $96,000) would still have to be paid, leaving only $14,000 profit, equivalent to less than a 5 percent return on the owner’s investment. The problem is further compounded in the following year because the business must then borrow more money (if it can) to finance working capital, and the extra interest on that further reduces profits and returns to the owner if the rate of return on total investment does not become higher than the borrowing rate.

**Volume-Cost-Profit Analysis**

Of all the traditional methods for making a preliminary assessment of proposed enterprises, volume-cost-profit analysis is the most useful coefficient for decisionmaking. It uses the same margin and general expense data that were outlined in the break-even and margin analysis above. It simply takes that data one step further to determine profitability over a range of annual sales volumes. This provides valuable insight into how sensitive the enterprise is to volume fluctuations.

This information is particularly important for new businesses, because there is normally a start-up period of several years during which volume builds up to the point of profitability. The capital requirements to build the business while financing losses of early years must be known, first, to decide if the venture is worth pursuing, and second, to identify the size and technology that looks most promising. Much of the preliminary
assessment of an investment consists of judging whether financing, both equity and debt, can be obtained in sufficient amounts to survive the start-up years.

The volume-cost-profit calculations are straightforward and can be done quickly by hand or using a simple computer spreadsheet. The steps, as depicted for the example in Table 5.11, are as follows:

1. Calculate contribution margin per ton in the same way it was calculated for break-even analysis (selling price per ton minus direct cost of sales per ton).
2. Multiply contribution margin per ton by each volume in a selected range of output to determine the total contribution margin at each of these volumes, putting the result in tabular form as indicated.
3. From each of these “total contribution margin” figures, subtract total “general expense,” and the result is “total profit (loss)” for that volume. Again, put these results in tabular form, as indicated.

Selecting the Plant for Full Financial Analysis

A word of caution is in order about interpreting the results of these calculations. Over some reasonable range of capacity utilization (probably from about 50 percent of rated capacity to the 80 percent of rated capacity, which we are using as “real” capacity), the cost of sales per ton will be fairly constant, and total general expense is unlikely to change much. At very low volumes, however, the cost of sales per ton will be higher for various reasons—plant labor may be paid for a full day but have only a half-day supply of raw material, packaging costs may be higher because bulk purchases cannot be made, and so on. At very high volumes, physical and financial inefficiencies are inevitable—the plant becomes too crowded, heavily used equipment breaks down and the large production crew stands and waits until repairs are done, and overtime pay increases hourly running costs. Also, general expenses will increase at very high volumes—there will be more management and office personnel and equipment, plus higher utilities and insurance costs.

The volume-cost-profit estimates in the Table 5.11 can be used not only to assess the impact of volume fluctuations, but also to estimate the impact of delays in getting up to volume, in terms of capital requirements and likely viability.
Table 5.11 Volume-Cost-Profit Analysis by Plant Size
(U.S dollars)

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selling price</td>
<td>US$/ton</td>
<td>300.00</td>
<td>300.00</td>
<td>300.00</td>
</tr>
<tr>
<td>Direct cost of sales</td>
<td>US$/ton</td>
<td>200.00</td>
<td>162.50</td>
<td>147.35</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>US$/ton</td>
<td>100.00</td>
<td>137.50</td>
<td>152.65</td>
</tr>
<tr>
<td>Total contribution margin</td>
<td>Tons/yr</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,000</td>
<td>100,000</td>
<td>137,500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,500</td>
<td>150,000</td>
<td>206,250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,000</td>
<td>200,000</td>
<td>275,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,500</td>
<td>250,000</td>
<td>343,750</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3,000</td>
<td>300,000</td>
<td>412,500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3,500</td>
<td>—</td>
<td>481,250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4,000</td>
<td>—</td>
<td>550,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5,000</td>
<td>—</td>
<td>687,500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6,000</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7,000</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8,000</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9,000</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10,000</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Fixed costs</td>
<td>US$</td>
<td>203,800</td>
<td>440,000</td>
<td>742,000</td>
</tr>
<tr>
<td>Total profit (loss) at</td>
<td>Tons/yr</td>
<td>(-203,800)</td>
<td>(-440,000)</td>
<td>(-742,000)</td>
</tr>
<tr>
<td>given sales level</td>
<td></td>
<td>1,000</td>
<td>(-103,800)</td>
<td>(-302,500)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,500</td>
<td>(-53,800)</td>
<td>(-233,750)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,000</td>
<td>(-3,800)</td>
<td>(-165,000)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,500</td>
<td>46,200</td>
<td>(-96,250)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3,000</td>
<td>96,200</td>
<td>(-27,500)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3,500</td>
<td>—</td>
<td>41,250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4,000</td>
<td>—</td>
<td>110,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5,000</td>
<td>—</td>
<td>247,500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6,000</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7,000</td>
<td>—</td>
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<tr>
<td></td>
<td></td>
<td>8,000</td>
<td>—</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>9,000</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10,000</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

— Not available.
The small plant is constrained by supply in Year 1 to a maximum of 1,400 tons of finished product, so would lose perhaps $55,000 that year. Supply again restricts it to 2,100 tons of product in Year 2, but that is enough to just more than break even. By Year 3 the only constraint is its own capacity, and the $36,000 annual profit will soon compensate for early losses. It is feasible.

The medium plant would lose about $210,000 in the first year at 1,600 tons unless supply and demand can be increased to reduce the losses. In Year 2, at 2,400 product tons, it would lose another $100,000. Adding a loss of about $27,500 in Year 3, losses by then could add up to around $350,000. A profit of $110,000 in Year 4 and subsequent years can start to recover the losses. By Year 5, minor plant renovations and very high capacity utilization could improve on the $110,000 profit, although not likely to the theoretical $247,500 calculated in the volume-cost-profit table. If enough equity and debt financing can be arranged, the medium plant looks feasible.

The large plant has serious problems. At less than half capacity during the first three years, losses would be even greater than indicated in the table. Successive losses of at least $500,000, $360,000, $284,000, and $131,000 total to almost $1,300,000 before breaking even in Year 5. Without even counting the extra cost of capital to finance these losses, the effect is to increase total investment from $2,200,000 to $3,500,000, with still many years before capacity can be reached.

Having ruled out the large plant, should the small plant or the medium plant be recommended? Both look viable, with similar payback periods and rates of return on investment. The small plant reaches profitability earlier because of its lower break-even volume, but if the total market potential is to be filled, the two small plants combined would reach break-even about the same time as the medium plant. If our enterprise were engaged in primary processing as described in Chapter 3, and if raw material supplies were located in more than one area, two small plants might be the best choice. Under most circumstances, a couple of market factors favor the medium plant—its higher technology means that quality control will probably be better, and its larger volume under one management helps create "critical mass" in the marketplace without adding the cost of a coordinating unit that would be needed to achieve the same volume from two small plants. Furthermore, it is an opportunity to develop more technological and management skills in the developing economy, and let us say that we are confident that the extra financing can be found.
Table 5.12. Summary of Capacity, Supply, and Market Constraints for Medium Plant (tons)

<table>
<thead>
<tr>
<th>Year</th>
<th>&quot;Real&quot; Maximum Capacity (Product)</th>
<th>Supply Maximum at 80% Recovery (Product)</th>
<th>Likely Market Available (Product)</th>
<th>Realistic Volume Estimates (Product)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4,000</td>
<td>1,600</td>
<td>2,000</td>
<td>1,600</td>
</tr>
<tr>
<td>2</td>
<td>4,000</td>
<td>2,400</td>
<td>2,500</td>
<td>2,400</td>
</tr>
<tr>
<td>3</td>
<td>4,000</td>
<td>4,800</td>
<td>3,000</td>
<td>3,000</td>
</tr>
<tr>
<td>4</td>
<td>4,000</td>
<td>9,600</td>
<td>5,000</td>
<td>4,000</td>
</tr>
</tbody>
</table>

If these considerations prevail, the analyst will choose the medium plant for a more detailed investigation of financial feasibility. Our examples from this point on are based on the parameters and coefficients developed for this medium plant.

Realistic estimates of supply and demand volumes are the basis for assessing early survivability of the business. These volumes are repeated for our example in Table 5.12. Raw material supply limits are converted through the 80 percent "recovery rate" of the medium plant to express them in terms of finished product per year. The constraining factors by year are supply in Years 1 and 2, market demand in Years 3 and 4, and "real" capacity in Years 4 and 5. The pattern resulting from these constraints represents the realistic volume estimates for the buildup period of the enterprise.

Net Present Value and Internal Rate of Return

The gradual buildup of business volume evident in this example is typical of business ventures and is one of the reasons that average return calculations are not the best analytical tools. In addition, money received in the future does not have as great a value today as money received today. To take these issues into account in evaluating investment opportunities, the analyst must turn to techniques that discount future outflows and inflows, to relate them to present-day values.
Net present value (NPV) analysis specifies the target rate of return as the discount rate, then determines if that rate is achieved under the proposed investment by seeing whether the NPV is zero or greater.

Internal rate of return (IRR) analysis calculates the rate of return actually achieved by equating the present value of future outflows and inflows; then the decisionmaker compares that rate with the target rate of return. Using market prices, this calculation is an indication of long-term performance of the firm. Substituting economic prices, it is an indication of performance from the perspective of the national economy (see Chapter 7).

Appendix 2 of this chapter provides an introduction to these two analytical tools.

Comparison of Investment Criteria
As explained in the preceding section, several simple rules of thumb are often used to make investment decisions. The problem with all of them is that they fail to incorporate the effect of timing—the impact of when investments are made and when receipts of varying sizes are obtained. Only discounting techniques can incorporate the time factor in investment analysis.

Break-even estimates are useful for initial assessment of whether viability is likely. If the break-even volume (at a given price and cost relationship) appears to be easily achievable, further investigation is warranted. Similarly, if the break-even price (at a given volume and cost relationship) appears to be competitive in the market, then further investigation is warranted. But a break-even estimate does not show the effect of delays in reaching the required volume, nor does it indicate if one investment is better than another.

Payback period also uses a given volume and profit level to compare with the initial investment, so the measure is useful only when that volume can be reached almost immediately and then maintained there at stable levels from year to year.

Average return on investment is similar to payback period, so its usefulness is also limited in the same way—no adjustment for how long it takes to reach the stated volumes.

Volume-cost-profit analysis is particularly useful as a means of taking a quick look at the implications of taking some time to build up the volume of the business. Of all the tools for preliminary screening, this one is most
likely to keep the decision practical. It provides the basis for estimating how large a deficit is likely to develop, and how long it would have to be covered before positive cash flows and profits can be reached. However, this analysis needs to be taken further to assess and compare different patterns of net cash flow and profitability over time.

To conduct a comprehensive analysis of a proposed investment it is necessary to do a year-by-year forecast of financial results; then net present value (NPV) and internal rate of return (IRR) calculations can be applied to these annual forecasts to see if the investment can achieve the investor’s target rate of return. Both NPV and IRR do take into account the effect of timing, incorporating the fact that a dollar today may be worth more or less than two dollars in the future, depending on the opportunity cost of capital and how far into the future one must wait to get the money.

*Net present value* analysis has the advantage of incorporating the value of time in the calculations. Its main drawback in relation to IRR, is that being a value, it does not permit direct comparison of investments of different sizes. (A large NPV could as easily reflect a large project as a positive net cash flow.)

*Internal rate of return* is the best tool in general for comparing long-term performance and investment. IRR is calculated to facilitate a comparison of investments. NPVs are calculated for several discount rates to confirm that the IRR calculated is the correct one. As a result, both IRR and NPV are used for investment analysis.

Different types of investors and creditors emphasize different measures of viability. For example, institutional investors and development assistance agencies who take a long-term perspective on investment depend heavily on internal rate of return as an investment criterion. In contrast, commercial banks and private investors are more concerned with exposure to risk in the short run—political, commercial, and financial risk—and they are consequently more attentive to payback period and debt-service ratio. A comprehensive analysis should include all of the above criteria, and as well as an assessment of the social, economic, political, and managerial factors that make up the unique circumstances of the proposed project. Economic planners may also adjust certain market prices to compensate for distortions that affect the value of resources in the economy (see Chapter 7).
A Comparison of Payback Period and Rate of Return

Despite their limitations, payback period and average return on investment are valuable tools for the preliminary screening of several alternative proposed investments. In addition, because many businessmen are used to thinking in terms of payback period, the concept can prove useful in helping them determine an appropriate target IRR or discount rate to use for NPV calculations. The following table illustrates the approximate relationship between them.

<table>
<thead>
<tr>
<th>Payback (years)</th>
<th>IRR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>26</td>
</tr>
<tr>
<td>4</td>
<td>29</td>
</tr>
<tr>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>10</td>
<td>7</td>
</tr>
</tbody>
</table>

The minimum return an investor is likely to accept is the return on virtually risk-free government bonds or bank deposits. If the investor is a borrower, his cost of borrowing represents another threshold target rate—at rates of return below the borrowing rate, investing in debt-reduction is more profitable than investing in expansion.

On top of these minimum target rates, the investor will add extra requirements for growth objectives and some allowance for risk. An inflation rate must also be added if the investor wishes to protect the real value of the return on investment.
Making Allowance for Expansion

The examples given earlier in this chapter illustrate the heavy costs that result from investing in capacity that cannot be fully utilized within a reasonable period. On the other hand, there may be significant economies of scale from the larger-capacity plant if throughput volumes approach capacity.

Investment in fixed assets tends to be “lumpy”—we cannot install half a machine because we have only half as much raw material as the machine can handle. We could start with a smaller machine and then add another one as volume grows, but two smaller ones are usually more expensive to buy and operate than one larger one with double the capacity. However, the cause of excess capacity in most cases is not this lumpiness of capital, but rather overly optimistic estimates of supply and demand, combined with the failure to assess the financial implications of not reaching these volumes as quickly as hoped.

The first step in avoiding the excess capacity problem is to make sure that supply and demand estimates are as realistic as possible. The next step is to design the facility so that those components that do not offer large economies of scale can be expanded in a modular fashion as volumes grow. Also, given the “lumpiness” of some types of capital goods, it may be necessary to start with a full-scale core of processing equipment, but other investments could be postponed. Raw material storage units, for example, certainly can be installed on a modular basis. Consistent with lower initial volumes, some parts of the operation can remain labor-intensive with minimal equipment until it has been proven that volume is sufficient to justify the investment in efficiency-enhancing machinery.

The type of energy to be used will influence the degree of flexibility in scale of initial investment as well. Electricity taken from a public grid offers the greatest flexibility, as individual pieces of equipment can be ordered to suit volume needs. However, if the plant is to run on steam generated in its own boilers, there will be a large fixed cost in this system, and the economies of going to greater pressures and capacities are significant.

The volume-cost-profit analysis outlined above should be performed on the main options, to compare results at various volumes and growth rates. The full financial analysis incorporating NPV and IRR should also
be conducted for the most likely choices, especially if there is confidence in the volume estimates.

Working Capital and Enterprise Operations

Technically, working capital is the difference between current assets and current liabilities. Practically, working capital is the means of paying for purchases and operating costs. The second section of this chapter dealt with several prominent characteristics of agroindustrial enterprises, such as seasonality, long-term market cycles and weather uncertainties. Almost all of these put pressure on such enterprises to maintain extra reserves of working capital, at least during start-up and at critical periods of the year.

Importance of Working Capital

Remember, one feature of the environment in which agroindustries function is seasonality. A one-week delay in start-up to process a season's crop could mean the difference between profitability and failure for some agroindustries. If delay was caused by the lack of working capital to buy the crop or meet operating costs, that shortage has seriously altered the whole year's performance because volume lost in that week cannot, in many cases, be recouped later in the season.

The form of the working capital is important as well. It must provide purchasing power. If most of the working capital consists of large stocks of unsold inventory or old receivables, it will buy supplies and pay wages only if cash can be borrowed against these assets. In many countries, access to foreign exchange is a serious constraint on working capital. If a strong working capital position exists only in local currency but some crucial equipment and supplies must be imported before the crop can be processed, the business does not have the buying power it needs at the time it needs it.

Working capital should receive special attention when assessing cash requirements for the start-up period of an enterprise. Cash inflow during the early months of operation can be expected to develop slowly. For example, although the enterprise may plan and bill for payment within 30 days of shipment, contingency plans must be available in the event of slow initial collection of receivables. Problems will occur in shipment, billing, and collection—the post office may not even be aware of your
new address. It is therefore strongly recommended that, for purposes of planning working capital needs, the expected turnaround time for receivables be set well above the normal terms of trade. For example, if normal terms are net 30 days, do not plan on full payment until 90 days during the first 6-12 months.

Similarly, some suppliers will not be willing to extend credit to a new client. Many opening payments may have to be made with a certified check or irrevocable letter of credit and even those willing to invoice will require immediate payment. Start-up problems can also be expected to delay the production and sales efforts.

*Calculating Working Capital Needs*

For many industries, cash flow within the year is relatively stable from month to month, except for predictable peaks and troughs. Agroindustrial ventures seldom fit that pattern.

To make an accurate assessment of the working capital needs of an agroindustry, cash flow forecasts must be prepared on a monthly basis for at least a full year. In fact, if the enterprise is planning spot purchases of raw material during the harvest, weekly projections should be prepared for critical periods. The general format can be similar to the annual forecasts presented as "profit (loss)" and "changes in financial position" statements in the appendix to this chapter. However, it is usually preferable to prepare a separate table to list just cash receipts and cash disbursements, together with their exact timing. Make sure that this cash-flow forecast incorporates all the lead and lag times of financial transactions, so as to more accurately predict cash surplus and deficit balances by month.

It is most important to identify the peak cash requirement, and when it will occur. Then determine if that requirement can be met from your own resources or by borrowing. For any amount that must be borrowed, you will be required to demonstrate repayment capacity, so evidence of receivables or sales contracts will be useful. The cash-flow projection beyond the peak cash requirement will also demonstrate your repayment capacity.

Security in the form of tangible or financial assets will be required to some value in excess of the loan amount to provide the lender with a margin of security in case things do not go as well as expected. If the value of current assets (primarily inventory and receivables) at the time of peak cash requirement compares favorably with the peak loan request, the
lender may not seek additional collateral in the form of liens on other assets of the enterprise.

Depending upon the length of the production, processing, and marketing phases of operations—and remembering the 90-day receivable allowance for start-up operations—it is quite likely that working capital will be needed from sources other than income for six to nine months of plant operation, sometimes longer.

**Current Ratio and Debt-Equity Considerations**

To remain creditworthy, an enterprise must maintain satisfactory current and debt-equity ratios. In the short run—one seasonal cycle—it is the current ratio that signals the adequacy of funds needed to operate smoothly, cope with problems, and take advantage of opportunities. While conditions vary among enterprises, working capital will almost certainly have to be shored up in most cases, if the current ratio is less than 2. A better test of liquidity is the "acid" or "quick" ratio, which is similar to the current ratio except that the least liquid assets—inventory and prepaid expenses—are excluded. If the quick ratio is less than 1, external sources of working capital will almost certainly be needed. In either case, an equity injection may be required, or a term loan that increases working capital in the short run in exchange for future principal repayments.

The overall debt-equity ratio has more bearing on long-term viability. In order to survive crop failures and the troughs of long-term market cycles in adequate condition to take advantage of the good years, the enterprise will need strong equity reserves. The required ratio will vary by product and country but, as a rule of thumb, the business should at least prepare to raise more equity capital if the debt-equity ratio gets up to about 2:1, and really start scrambling for equity if the debt-equity ratio becomes 3:1 or higher. (The fact that many enterprises enter their development phase with even higher debt-equity ratios simply highlights the importance of conservative estimates of operating performance and tight management during this period.)

**The Full Financial Analysis**

The full financial analysis essentially builds on the volume-cost-profit analysis done in the preliminary screening stage. Assumptions and coefficients are fine-tuned by more thorough research into what is actually
likely to occur. The results are developed into a complete set of pro forma financial statements, and ratio analysis is used to assess the strengths and weaknesses of these statements. Cash flows are adjusted to permit calculation of net present value (NPV) and internal rate of return (IRR) on investment. Then sensitivity analysis is conducted to estimate the result of changes in key variables.

The analysis on the following pages is based on the “medium” plant discussed in the preceding section of this chapter. Table 5.13 presents most of the basic “assumptions and coefficients” used before. However, a number of new factors must be introduced and estimated. These are discussed in the following paragraphs.

ANALYSIS PERIOD. A period of 10 years is used here in order to capture the full impact of developmental stages and later, steady-state performance.

INFLATION FACTOR. This is assumed to be zero in the present example. If inflation were to affect revenues and costs equally, it would not change the rate of return. However, this is often not the case; some of the fixed costs such as depreciation and debt service on fixed rate term loans are not affected by inflation. As inflation drives up the contribution margin per ton, a smaller and smaller share of that margin is needed to meet fixed costs, leaving an increasing share for profit and net cash. Offsetting much of the beneficial effect of inflation is the fact that as depreciable assets wear out or become obsolete, replacing them becomes more and more expensive. The depreciation figure based on historical cost has been understating actual costs. The accounting profession is still debating how to make financial statements reflect the true performance of the business under inflationary circumstances.¹

¹ High inflation is often associated with currency devaluation, so a foreign lender or equity investor would probably get no benefit from local inflation—the contribution margin is larger in terms of currency, but not in terms of his own foreign currency. The prospective local owner of the business may take a different view, especially if he is highly leveraged with a local-currency loan and a large part of the assets are represented by land investment, which does not depreciate and is a traditional hedge against inflation.
INITIAL FINANCING AT START-UP. This factor is also the same as before. Note that the division of equity and loan financing of fixed assets is expressed as a percentage to facilitate the calculation of additional requirements of each if there are cost overruns.

OTHER DEBT FINANCING. This is new information compared with the preliminary screening analysis. Provision is made for interest on a "carry-over loan." Losses caused by low volumes in the early years must be financed somehow. If additional equity is not injected to cover the losses, then money must be borrowed. To make the analysis realistic, the interest cost on cash deficits must be added to other costs, on the assumption that such deficits are funded by an overdraft facility, for example. Similarly, the cost of operating capital borrowed from the bank must be added. Since the projections are on an annual basis, some estimate of average balance of the operating loan is made and the relevant interest rate applied. In our example, we calculate the average balance as a function of monthly sales, although there are other ways to estimate this average balance.

BAD DEBTS AS A PERCENTAGE OF SALES. This cost item is often ignored in projections, but is also added for realism.

INCOME TAX RATE. The tax rate is included as an average for after-tax profit and equity calculations. It should be noted that the tax calculations in the example are quite simplistic and do not take into account any special tax provisions such as "capital cost allowance" (the tax equivalent of depreciation) using a different rate or methodology than that used for management purposes. As a result, the after-tax calculation of the example adds little extra information for decisionmaking. It is included to demonstrate how tax liabilities may affect cash flows and balance sheet values, and to remind the analyst that the private investor will consider any special tax treatments an important part of his investment decision.

Preparing Detailed Capital Cost Estimates

Initial investment in fixed assets can determine the level of fixed costs for many years. The choice of equipment and design of the facility also determine a large proportion of the variable cost of sales. Thorough design and costing of the initial investment are therefore critical. (See Chapter 3 for a discussion of factors in the selection of processing facilities.)
### Table 5.13 Medium-Scale Agroindustry Processing Plant, Assumptions, and Coefficients

<table>
<thead>
<tr>
<th>Analysis period</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Year of startup/investment</td>
<td>0</td>
</tr>
<tr>
<td>First year of this analysis</td>
<td>1</td>
</tr>
<tr>
<td>Total years analyzed</td>
<td>10</td>
</tr>
<tr>
<td>Inflation factor</td>
<td></td>
</tr>
<tr>
<td>Inflation rate</td>
<td>0.0%</td>
</tr>
<tr>
<td>Inflation index</td>
<td>1.00 (all years)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Crop and other cost of sales</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total raw crop purchased (tons)</td>
<td>YR1 2,000, YR2 3,000, YR3 3,750, YR4 5,000, YRS5-10 5,000</td>
</tr>
<tr>
<td>&quot;Recovery rate&quot;</td>
<td>80%</td>
</tr>
<tr>
<td>Total product sold (tons)</td>
<td>YR1 1,600, YR2 2,400, YR3 3,000, YR4 4,000, YRS5-10 4,000</td>
</tr>
<tr>
<td>Price of raw product, ($/ton)</td>
<td>$70.00</td>
</tr>
<tr>
<td>Cost of Raw Product (ton of finished product)</td>
<td>$87.50</td>
</tr>
<tr>
<td>Other direct costs (ton of finished product)</td>
<td>$75.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Selling prices</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Product selling price ($/ton)</td>
<td>YRS 1-4 $300; YRS 5-10 $320</td>
</tr>
<tr>
<td>Co-product selling price ($/unit)</td>
<td>$0.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Initial financing at startup</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity injection for starting cash</td>
<td>$100,000</td>
</tr>
<tr>
<td>Percentage equity down payment on fixed assets</td>
<td>20.0</td>
</tr>
<tr>
<td>Percentage of startup fixed assets on term debt</td>
<td>80.0</td>
</tr>
<tr>
<td>Term debt interest rate (%)</td>
<td>12.0</td>
</tr>
<tr>
<td>Term debt length of term (years)</td>
<td>20</td>
</tr>
<tr>
<td>Term debt grace period (years)</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other debt financing</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest rate, carryover loan (%)</td>
<td>12.0</td>
</tr>
<tr>
<td>Interest rate, operating credit (%)</td>
<td>12.0</td>
</tr>
<tr>
<td>Months of sales financed by operating credit</td>
<td>1.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Miscellaneous coefficients</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bad debts as percentage of sales</td>
<td>1.0</td>
</tr>
<tr>
<td>Income tax rate, average (%)</td>
<td>20.00</td>
</tr>
<tr>
<td>Longest life fixed asset (years)</td>
<td>25</td>
</tr>
<tr>
<td>Next-longest life asset (years)</td>
<td>10</td>
</tr>
</tbody>
</table>
Compiling investment costs is a demanding task, requiring detailed designs, trade references, the solicitation of pro forma invoices and service quotations, and comparison shopping. The more complete the project design and the more comprehensive the shopping effort, the more accurate the estimates will prove to be. In practice, detailed costing of this nature may not be justified at the stage of investment analysis, and the analyst may settle for less precise specifications and quotes together with price and physical contingencies. The final costing will then be done in the context of financial negotiations and project implementation. In any event, the costing effort will include the following categories of assets: land, site development, utilities, buildings, plant equipment and machinery (c.i.f.), other equipment and machinery (c.i.f.), installation and start-up, vehicles, architectural and engineering services, and pre-operating charges.

While the actual cost tables will amount to many pages for some of these categories, a one-page summary of subtotals should be prepared for use in financial analysis as well as solicitation documents and progress reports.

Be sure to include any costs such as insurance, local transport, and handling charges that are required to arrive at a total cost delivered at the site. Also determine the local tax component (excise tax, import tax, etc.), as well as any foreign exchange component of the cost so that these can be used in negotiations with government authorities concerning relevant investment incentives. (These components are also used to adjust benefit and cost streams for the economic analysis.) If the analysis shows that a small overrun in construction and installation costs or timing may determine whether or not the project proceeds, then a fully detailed engineering study is advisable before the investment decision is made. Even if there appears to be room for overruns, the release of funds by investors and creditors will likely be conditional on the detailed engineering study confirming the capital costs and operating coefficients.

Table 5.14 presents an abbreviated example of a list of investments and their costs. It simplifies what in practice would be a detailed schedule; the list would be longer, and the economic life of assets might vary from less than 5 years to as much as 40 years. The classification based on either 10 or 25 years keeps the calculations simple in this example while illustrating the principle. Straight-line depreciation is used here and is recommended for financial analysis unless there are known tax benefits
Table 5.14 Size and Investment Parameters

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost (US$)</th>
<th>Economic Life (years)</th>
<th>Annual Depreciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land (leased)</td>
<td>0</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>Site development</td>
<td>100,000</td>
<td>25</td>
<td>4,000</td>
</tr>
<tr>
<td>Utilities</td>
<td>150,000</td>
<td>25</td>
<td>6,000</td>
</tr>
<tr>
<td>Buildings</td>
<td>250,000</td>
<td>25</td>
<td>10,000</td>
</tr>
<tr>
<td>Plant equipment/machinery</td>
<td>400,000</td>
<td>10</td>
<td>40,000</td>
</tr>
<tr>
<td>Other equipment/machinery</td>
<td>100,000</td>
<td>10</td>
<td>10,000</td>
</tr>
<tr>
<td>Total</td>
<td>1,000,000</td>
<td></td>
<td>70,000</td>
</tr>
</tbody>
</table>

Plant Capacity (tons) with Plant in Operation Three Months per Year
(Rated capacity: Raw materials—10 tons/hour; Output—8 tons/hour)

<table>
<thead>
<tr>
<th>Equivalent to:</th>
<th>Rated</th>
<th>Real (80%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal 8-hour day</td>
<td>64</td>
<td>51.2</td>
</tr>
<tr>
<td>Normal 20-day month</td>
<td>1,280</td>
<td>1,024.0</td>
</tr>
<tr>
<td>Peak 16-hour day</td>
<td>128</td>
<td>102.4</td>
</tr>
<tr>
<td>Annual output (1 peak month/2 normal)</td>
<td>2,560</td>
<td>2,048.0</td>
</tr>
</tbody>
</table>

n.a. Not applicable.

to be derived from using another method. The straight-line method is simple to use, and as the period of analysis is increased, the impact of different depreciation methods declines.

Table 5.14 also contains an example of how the plant's rated hourly capacity can be translated into "real" capacity for different operating periods.

Undertaking the Full Analysis

Having established initial investment costs, the analyst can proceed to prepare pro forma financial statements. The first step will be to project the financial transactions relating to fixed assets.
Fixed asset transactions and balances are presented in Table 5.15 together with the term debt financing associated with them.\(^2\)

Capital disbursements show the outflow of cash for the assets. For simplicity, these capital purchases are counted as being made on the last day of the construction year preceding the first operating year. The term loan proceeds are used on that day to pay for all costs (including construction financing costs) incurred up to that completion point.

Depreciation is calculated for each year. Capital disbursements are inserted in year 10 to replace the 10-year assets.

Undepreciated cost is the original cost of the asset less depreciation to date and represents the book value or residual value of the assets.

The term loan is evidently made on somewhat concessional terms because principal payments of $40,000 per year are lower than the $70,000 annual depreciation. In 10 years, when equipment has to be replaced, the loan will be down to only $400,000, but the residual value of all fixed assets will be down by $700,000, to $300,000. By that time the firm will have had to earn or obtain additional equity to support the purchase of replacement equipment.

Pro forma profit and loss statements are presented in Table 5.16. All the elements necessary to make this projection have been discussed in previous sections and in Table 5.15. Note that Table 5.16 has been simplified in that no annual adjustments are made to cost of sales for beginning and ending inventory positions. In practice, these inventory adjustments are important to understand conditions in any individual year, but they rapidly lose significance for analytical purposes as the period of analysis increases.

As discussed in the volume-cost-profit analysis, losses are incurred until volume reaches 4,000 tons in Year 4. In this full analysis, costs of the deficit carryover loan, operating interest and bad debts have been incorporated.

Pro forma changes in financial position are presented in Table 5.17, again in simplified form. Total sources must equal total applications. Since the accumulated cash flow deficit peaks at $150,000 in approximately 2 years, the investor should consider starting off with an extra $150,000 in equity, in addition to the $300,000 shown in the Table 5.17. Otherwise, the deficit will have to be financed by a loan.

\(^2\) Tables 5.15 to 5.20 are grouped together after this section.
Table 5.15 Fixed Assets and Term Debt Transactions
(currency figures in thousands of dollars unless otherwise stated)

<table>
<thead>
<tr>
<th>Item</th>
<th>Total $</th>
<th>No Years</th>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Disbursements for fixed assets</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25-year assets</td>
<td>500</td>
<td>25</td>
<td>500</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10-year assets</td>
<td>500</td>
<td>10</td>
<td>500</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>500</td>
</tr>
<tr>
<td>Total disbursements for fixed assets</td>
<td>1,000</td>
<td></td>
<td>1,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>500</td>
</tr>
<tr>
<td><strong>Depreciation (straight-line)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>25-year assets</td>
<td>500</td>
<td>25</td>
<td>0</td>
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<td>20</td>
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<td>20</td>
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<td>20</td>
<td>20</td>
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<td>20</td>
<td>20</td>
</tr>
<tr>
<td>10-year assets</td>
<td>500</td>
<td>10</td>
<td>0</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Total depreciation</td>
<td>1,000</td>
<td></td>
<td>70</td>
<td>70</td>
<td>70</td>
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<td>70</td>
<td>70</td>
<td>70</td>
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</tr>
<tr>
<td><strong>Undepreciated cost</strong></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>25-year assets</td>
<td>500</td>
<td></td>
<td>480</td>
<td>460</td>
<td>440</td>
<td>420</td>
<td>400</td>
<td>380</td>
<td>360</td>
<td>340</td>
<td>320</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>10-year assets</td>
<td>500</td>
<td></td>
<td>450</td>
<td>400</td>
<td>350</td>
<td>300</td>
<td>250</td>
<td>200</td>
<td>150</td>
<td>100</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Total undepreciated cost</td>
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<td>930</td>
<td>860</td>
<td>790</td>
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<td>510</td>
<td>440</td>
<td>370</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td><strong>Term debt financing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest rate year (percent)</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of term (years)</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Grace period (years)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Loan as percentage of cost</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amount borrowed (at end of construction year)</td>
<td>800</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Opening loan balance</td>
<td>0</td>
<td>800</td>
<td>760</td>
<td>720</td>
<td>680</td>
<td>640</td>
<td>600</td>
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<td>480</td>
<td>440</td>
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</tr>
<tr>
<td>Principal repayment</td>
<td>0</td>
<td>40</td>
<td>40</td>
<td>40</td>
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<td>40</td>
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<td>40</td>
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<td>Interest payment on term loan</td>
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<td>91</td>
<td>86</td>
<td>81</td>
<td>76</td>
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<td>Total principal and interest payment</td>
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<td>131</td>
<td>126</td>
<td>121</td>
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<td>112</td>
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### Table 5.16 Pro-Forma Profit and Loss Statement
(currency figures in thousands of dollars unless otherwise stated)

<table>
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<td><strong>Sales</strong></td>
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<td></td>
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<td></td>
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<tr>
<td>Total raw material purchased (thousands of tons)</td>
<td>0</td>
<td>2.0</td>
<td>3.0</td>
<td>3.75</td>
<td>5.0</td>
<td>5.0</td>
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<td>Total raw product sold (thousands of tons)</td>
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<td>2.4</td>
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<td>Product Selling Price ($/ton)</td>
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<td>300.0</td>
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<td>320.0</td>
<td>320.0</td>
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<td>Sales, main product</td>
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<td>900.0</td>
<td>1,200.0</td>
<td>1,280.0</td>
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<td>Sales, co-product</td>
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<td><strong>Total sales revenue</strong></td>
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<td>720.0</td>
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<td>1,280.0</td>
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<tr>
<td><strong>Direct cost of sales</strong></td>
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<tr>
<td>Cost of raw material</td>
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<td>180.0</td>
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<td>General overhead expense</td>
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<td>12.8</td>
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<tr>
<td>Interests, def. carryover loan</td>
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<td>35.0</td>
<td>35.0</td>
<td>35.0</td>
<td>35.0</td>
<td>35.0</td>
<td>35.0</td>
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<tr>
<td>Interest, term loan</td>
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<td>76.8</td>
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<td>70.0</td>
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<td>70.0</td>
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<tr>
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<td>422.4</td>
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<td><strong>Net operating income</strong></td>
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<td>-205.6</td>
<td>-104.7</td>
<td>-30.0</td>
<td>106.4</td>
<td>205.9</td>
<td>212.4</td>
<td>217.2</td>
<td>222.0</td>
<td>226.8</td>
<td>231.6</td>
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<tr>
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<tr>
<td>Net profit (loss) pre-tax</td>
<td>0</td>
<td>-205.6</td>
<td>-104.7</td>
<td>-30.0</td>
<td>106.4</td>
<td>205.9</td>
<td>212.4</td>
<td>217.2</td>
<td>222.0</td>
<td>226.8</td>
<td>231.6</td>
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<td>Income tax</td>
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<td>-20.9</td>
<td>-6.0</td>
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<td>42.5</td>
<td>43.4</td>
<td>44.4</td>
<td>45.4</td>
<td>46.3</td>
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<tr>
<td><strong>Net profit (loss) after tax</strong></td>
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<td>-164.5</td>
<td>-43.3</td>
<td>-24.0</td>
<td>85.1</td>
<td>164.7</td>
<td>169.9</td>
<td>173.8</td>
<td>177.6</td>
<td>181.4</td>
<td>185.3</td>
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<td>Cumulative tax credit</td>
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<td>88.1</td>
<td>66.8</td>
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<td>Tax paid in current year</td>
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<td>0</td>
<td>0</td>
<td>36.9</td>
<td>43.4</td>
<td>44.4</td>
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Table 5.17 Pro forma Changes in Financial Position  
(currency figures in thousands of dollars unless otherwise stated)

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<td>Sources</td>
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<td>(205.6)</td>
<td>(104.7)</td>
<td>(29.9)</td>
<td>106.4</td>
<td>207.6</td>
<td>212.4</td>
<td>217.2</td>
<td>222.0</td>
<td>226.8</td>
<td>231.6</td>
</tr>
<tr>
<td>Net profit (loss) pre-tax</td>
<td>0.0</td>
<td>70.0</td>
<td>70.0</td>
<td>70.0</td>
<td>70.0</td>
<td>70.0</td>
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<td>70.0</td>
<td>70.0</td>
<td>70.0</td>
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<tr>
<td>Plus noncash expenditures, depreciation</td>
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<td>0.0</td>
<td>0.0</td>
<td>(37.2)</td>
<td>(43.4)</td>
<td>(44.4)</td>
<td>(45.4)</td>
<td>(45.4)</td>
<td>(46.3)</td>
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<tr>
<td>Less income tax paid in year</td>
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<td>0.0</td>
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<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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<tr>
<td>Net funds from operations</td>
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<td>(135.6)</td>
<td>(34.7)</td>
<td>40.1</td>
<td>176.4</td>
<td>277.6</td>
<td>245.2</td>
<td>243.8</td>
<td>247.6</td>
<td>251.4</td>
<td>255.3</td>
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<td>Increase in term loans</td>
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<td>Equity injection (e.g., sales of shares)</td>
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</tr>
<tr>
<td>Total sources of funds</td>
<td>1,100.0</td>
<td>(135.6)</td>
<td>(34.7)</td>
<td>40.1</td>
<td>176.4</td>
<td>277.6</td>
<td>245.2</td>
<td>243.8</td>
<td>247.6</td>
<td>251.4</td>
<td>255.3</td>
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<td>Dividends etc. paid out</td>
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<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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<td>0.0</td>
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<tr>
<td>Subtotal</td>
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<td>40.0</td>
<td>40.0</td>
<td>40.0</td>
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<td>40.0</td>
<td>40.0</td>
<td>40.0</td>
<td>540.0</td>
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<tr>
<td>Change in cash balance-net cash flow</td>
<td>100.0</td>
<td>(175.6)</td>
<td>(74.7)</td>
<td>0.1</td>
<td>136.4</td>
<td>237.6</td>
<td>205.2</td>
<td>203.8</td>
<td>207.6</td>
<td>211.4</td>
<td>(24.7)</td>
</tr>
<tr>
<td>Total applications of funds</td>
<td>1,100.0</td>
<td>(135.6)</td>
<td>(34.7)</td>
<td>40.1</td>
<td>176.4</td>
<td>277.6</td>
<td>245.2</td>
<td>243.8</td>
<td>247.6</td>
<td>251.4</td>
<td>255.3</td>
</tr>
<tr>
<td>Cumulative change in cash balance</td>
<td>100.0</td>
<td>(75.6)</td>
<td>(150.3)</td>
<td>(150.2)</td>
<td>(13.8)</td>
<td>223.8</td>
<td>429</td>
<td>632.8</td>
<td>840.4</td>
<td>1,051.8</td>
<td>767.1</td>
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</table>
Summary Balance Sheet at Year-End

Comparative balance sheets resulting from the projected operation are presented in Table 5.18. These statements have been simplified by omitting inventory and account receivable balances in current assets, for example, and accounts payable in current liabilities. The current ratio will not, therefore, give an accurate indication of liquidity. However, the overall debt-equity ratios presented as the note at the bottom of Table 5.18 are cause for serious concern about the ability of this business to survive. By the end of Year 4, equity has virtually disappeared, and the result is an astronomical debt-equity ratio. Only with some form of third-party guarantee would a lender provide financing to cover losses at this stage. If a minimum of 3:1 debt-equity ratio were required for normal credit, for example, total equity would have to be increased by one-third of the $830,000 liabilities (i.e., $277,000). It would therefore be prudent to recommend that the sponsors increase initial equity in the venture by at least $250,000.

Internal Rate of Return and Net Present Value Calculations

In order to calculate internal rate of return and net present value, two types of adjustments must be made to net cash flow as it appears in the statement of changes in financial position. The first is to remove the effect of term and carryover loans and equity transactions so that the analysis is independent of how investments and operations are financed. The second is to take into account the value of assets on hand at the end of the analysis period. These adjustments and the IRR and NPV calculations for our example are presented in Table 5.19.

The examples in this chapter have been prepared with the aid of a computerized spreadsheet program that performs the calculation of IRR and NPV electronically. The calculation can also be done manually using present value (PV) tables, in which case you must do a separate present value calculation for each year, then add up the results of all these calculations (including the negative flow of “Year 0” construction costs). Start with a discount rate equal to the opportunity cost of capital to determine if NPV was positive. Then, to calculate the internal rate of return, repeat the calculations at discount rates that you estimate would make NPV equal to zero. Through this trial-and-error method, identify the discount rate that equates NPV to zero: that is the IRR.
Table 5.18 Pro Forma Balance Sheets at Year-End
(currency figures in thousands of dollars unless otherwise stated)

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>1</th>
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<td><strong>Assets</strong></td>
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<td></td>
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<tr>
<td>Cash balance</td>
<td>100.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>223.8</td>
<td>429.0</td>
<td>632.8</td>
<td>840.4</td>
<td>1,051.8</td>
<td>767.1</td>
</tr>
<tr>
<td>Tax credit</td>
<td>0.0</td>
<td>41.1</td>
<td>62.1</td>
<td>68.0</td>
<td>46.8</td>
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<td>0.0</td>
<td>0.0</td>
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<tr>
<td>Current assets</td>
<td>100.0</td>
<td>41.1</td>
<td>62.1</td>
<td>68.0</td>
<td>46.8</td>
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<td>429.0</td>
<td>632.8</td>
<td>840.4</td>
<td>1,051.8</td>
<td>767.1</td>
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<td>Fixed assets at book value</td>
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<td>860.0</td>
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<td>650.0</td>
<td>580.0</td>
<td>510.0</td>
<td>440.0</td>
<td>370.0</td>
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<td>922.1</td>
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<td>789.0</td>
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</tr>
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<td>Debt carryover loan</td>
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<td>40.0</td>
<td>40.0</td>
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<td>40.0</td>
<td>40.0</td>
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<tr>
<td>Current portion of term debt</td>
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<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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<td>0.0</td>
<td>0.0</td>
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<td>53.8</td>
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<td>720.0</td>
<td>680.0</td>
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<td>600.0</td>
<td>560.0</td>
<td>520.0</td>
<td>480.0</td>
<td>440.0</td>
<td>400.0</td>
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<tr>
<td>Less current portion of term loan</td>
<td>0.0</td>
<td>(40.0)</td>
<td>(40.0)</td>
<td>(40.0)</td>
<td>(40.0)</td>
<td>(40.0)</td>
<td>(40.0)</td>
<td>(40.0)</td>
<td>(40.0)</td>
<td>(40.0)</td>
<td>(40.0)</td>
</tr>
<tr>
<td><strong>Total term liabilities</strong></td>
<td>800.0</td>
<td>720.0</td>
<td>680.0</td>
<td>640.0</td>
<td>600.0</td>
<td>560.0</td>
<td>520.0</td>
<td>480.0</td>
<td>440.0</td>
<td>400.0</td>
<td>360.0</td>
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<tr>
<td><strong>Total liabilities</strong></td>
<td>800.0</td>
<td>835.6</td>
<td>870.3</td>
<td>830.2</td>
<td>653.8</td>
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<td>560.0</td>
<td>520.0</td>
<td>480.0</td>
<td>440.0</td>
<td>400.0</td>
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<tr>
<td><strong>Equity</strong></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Beginning retained earnings</td>
<td>0.0</td>
<td>0.0</td>
<td>(164.5)</td>
<td>(248.3)</td>
<td>(272.1)</td>
<td>(187.0)</td>
<td>(20.0)</td>
<td>149.0</td>
<td>322.8</td>
<td>500.4</td>
<td>681.8</td>
</tr>
<tr>
<td>Plus net profit (loss)</td>
<td>0.0</td>
<td>(164.5)</td>
<td>(83.8)</td>
<td>(23.9)</td>
<td>85.1</td>
<td>166.1</td>
<td>169.9</td>
<td>173.8</td>
<td>177.6</td>
<td>181.4</td>
<td>185.3</td>
</tr>
<tr>
<td>Less dividends</td>
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<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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<tr>
<td>Share capital</td>
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<td>300.0</td>
<td>300.0</td>
<td>300.0</td>
<td>300.0</td>
<td>300.0</td>
<td>300.0</td>
<td>300.0</td>
<td>300.0</td>
<td>300.0</td>
</tr>
<tr>
<td><strong>Total equity</strong></td>
<td>300.0</td>
<td>135.5</td>
<td>51.7</td>
<td>27.8</td>
<td>113.0</td>
<td>279.0</td>
<td>449.0</td>
<td>622.8</td>
<td>800.4</td>
<td>981.8</td>
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<td>858.0</td>
<td>766.8</td>
<td>879.1</td>
<td>1,009.0</td>
<td>1,142.8</td>
<td>1,280.4</td>
<td>1,421.8</td>
<td>1,567.1</td>
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### Table 5.19 Internal Rate of Return and Net Present Value Calculations

(*currency figures in thousands of dollars*)

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<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Net cash flow</strong> (Change in financial position, Table 5.17)</td>
<td>100.0</td>
<td>(175.6)</td>
<td>(74.7)</td>
<td>0.1</td>
<td>136.4</td>
<td>237.6</td>
<td>205.2</td>
<td>203.8</td>
<td>207.6</td>
<td>211.4</td>
<td>(284.7)</td>
</tr>
<tr>
<td><strong>Remove the effect of financing method</strong></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Add back payments on term loan</td>
<td>0.0</td>
<td>40.0</td>
<td>40.0</td>
<td>40.0</td>
<td>40.0</td>
<td>40.0</td>
<td>40.0</td>
<td>40.0</td>
<td>40.0</td>
<td>40.0</td>
<td>40.0</td>
</tr>
<tr>
<td>Add back term interest paid</td>
<td>0.0</td>
<td>96.0</td>
<td>91.2</td>
<td>86.4</td>
<td>81.6</td>
<td>76.8</td>
<td>72.0</td>
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<td>62.4</td>
<td>57.6</td>
<td>52.8</td>
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<tr>
<td>Add back carryover interest paid</td>
<td>0.0</td>
<td>0.0</td>
<td>9.1</td>
<td>18.0</td>
<td>18.0</td>
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<td>Deduct equity received</td>
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<tr>
<td>Deduct term debt received</td>
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<tr>
<td><strong>Add back residual value of fixed assets</strong></td>
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<td></td>
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<tr>
<td>Residual value, year-end 10</td>
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<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>800.0</td>
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<tr>
<td><strong>Total flows for IRR and NPV purposes</strong></td>
<td>(1,000.0)</td>
<td>(39.6)</td>
<td>65.6</td>
<td>144.5</td>
<td>276.0</td>
<td>354.4</td>
<td>317.2</td>
<td>311.0</td>
<td>310.0</td>
<td>309.0</td>
<td>608.1</td>
</tr>
<tr>
<td><strong>Internal rate of return (%)</strong></td>
<td>15.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Net present value at (%)</strong></td>
<td>3.0</td>
<td>125.3</td>
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<td>10.0</td>
<td>349.2</td>
<td></td>
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<td></td>
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<td></td>
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<tr>
<td></td>
<td>20.0</td>
<td>(170.9)</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>25.0</td>
<td>(303.5)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>30.0</td>
<td>(390.2)</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Sensitivity Analysis: The Modeling of Risk

No one can predict the future with complete accuracy. After careful investigation of markets, supply potential, costs, management ability and business environment, the analyst prepares financial projections on the basis of his or her judgment of the most likely outcome. This is the "best estimate" scenario. But what if it turns out that the price is closer to the bottom of the range, or that start-up is delayed, or that any of a number of key factors is closer to the extremes of the range than to the middle of the range? If financial analysis is to be a practical decisionmaking tool, it must be able to answer the major "what-if" questions.

When the analysis is being done on a computer, most programs provide a relatively fast way of calculating the financial implications of different values of major variables in the forecast. If the analysis is being done manually, working through all the interrelationships of changing just one coefficient can be time-consuming and expensive. By either method, it is virtually impossible to consider all the possible permutations and combinations.

To make the information on sensitivity most useful for decisionmaking, limit the "what-if" scenarios to several key factors in the success of the enterprise, and to a reasonable range of values for these success factors. Then assess the impact of these scenarios only on key measures of financial performance and condition.

The success of an agroindustrial enterprise usually depends on the following factors: prices (and gross profit margin per unit of product); volume; recovery rate; cost overruns in establishment costs; start-up delays, especially in sales; and volume-cost-profit relationships (combinations of the above). The measures of financial performance are those related to solvency (cash flow, working capital, debt-servicing capacity), profitability (P&L, IRR), and risk-bearing ability (balance sheet values, debt/equity).

When the financial analysis is being done by hand, time constraints place a practical limit on the number and sophistication of sensitivity measures. Under these circumstances, the results of earlier phases of the analysis can be interpreted for different scenarios. For example,

- The impact of cost overruns on IRR can be judged by the NPVs for a number of discount rates already calculated in the manual analysis. In our example (see Table 5.19), the NPV of the investment was $587,835 at a discount rate of 10 percent. If 10 percent was the tar-
get rate of return ("real," after inflation), a cost overrun of up to $587,835 could be endured. On the other hand, if the target rate of return was close to the 18.8 percent where NPV equals zero, the enterprise could not afford any cost overrun.

- Break-even prices and volumes by year are limited types of sensitivity measures that can be employed even when the analysis is done by hand. If the volumes used in the base scenario come to pass, break-even price allows us to say that if our prices are higher than this we will be making a profit. If the prices used in the base scenario come to pass, break-even volume allows us to say that if our volumes are higher than this we will be making a profit. Neither tells us how big the profit (or loss) will be at higher (or lower) prices and volumes.

- The volume-cost-profit calculations discussed earlier in this chapter can be used to determine manually the size of profit (loss) at various volumes and prices or margins.

When the analysis is being done by computer, more thorough sensitivity analysis can be done. Table 5.20 shows break-even prices and volumes plus several other "what-if" scenarios.

**Selected Sensitivity Tests**

The following paragraphs describe a number of sensitivity tests from Table 5.20.

**Effect of Selling Price on Rate of Return.** The return on investment in our model is very sensitive to changes in selling price. For example, if there is a price change of $50/ton above or below the base case rice—a change of less than 20 percent—the rate of return swings between -1 percent and +30 percent, compared with the base 19 percent. This sensitivity to price fluctuations indicates that, everything else being equal, the business is at high risk because of the inevitability of such price swings in agroindustrial products. The business will need very deep pockets to ride out price swings. In addition, its management strategy should be flexible on operating costs so that it can maintain an acceptable gross profit margin per ton even when the selling price declines (e.g., price paid for raw material must be tied closely to final product price).
Table 5.20 Sensitivity Tests  
(currency figures in thousands of dollars unless otherwise stated)

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<th>Test</th>
<th>Year</th>
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<th>7</th>
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<tbody>
<tr>
<td>1. Break-even prices at base-case volumes ($/ton)</td>
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<td>428.5</td>
<td>343.6</td>
<td>310.0</td>
<td>273.4</td>
<td>268.5</td>
<td>266.9</td>
<td>265.7</td>
<td>264.5</td>
<td>263.3</td>
<td>262.1</td>
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<tr>
<td>2. Break-even volumes sold at base-case prices (thousand tons)</td>
<td></td>
<td>3.10</td>
<td>3.16</td>
<td>3.22</td>
<td>3.23</td>
<td>2.69</td>
<td>2.65</td>
<td>2.62</td>
<td>2.59</td>
<td>2.56</td>
<td>2.53</td>
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<td>3. Impact of changes in selling price</td>
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<td></td>
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<td></td>
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<tr>
<td>US$/Ton</td>
<td>IRR</td>
<td>Net Cash Flow</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>250</td>
<td>-3.8</td>
<td>(284.0)</td>
<td>125.8</td>
<td>(28.4)</td>
<td>45.2</td>
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<td>74.5</td>
<td>91.8</td>
<td>107.5</td>
<td>112.3</td>
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<tr>
<td>300</td>
<td>13.1</td>
<td>(164.3)</td>
<td>106.4</td>
<td>(29.9)</td>
<td>106.4</td>
<td>212.4</td>
<td>217.2</td>
<td>222.0</td>
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<tr>
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<td>24.6</td>
<td>(127.3)</td>
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<td>233.9</td>
<td>326.9</td>
<td>331.7</td>
<td>336.5</td>
<td>341.3</td>
<td>346.1</td>
<td>350.9</td>
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<td>4. Impact of changes in recovery rate</td>
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<tr>
<td>Rate (%)</td>
<td>IRR (%)</td>
<td>Net Cash Flow</td>
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<tr>
<td>70%</td>
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<td>(294.1)</td>
<td>125.8</td>
<td>(28.4)</td>
<td>45.2</td>
<td>59.0</td>
<td>74.5</td>
<td>91.8</td>
<td>107.5</td>
<td>112.3</td>
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<td>80%</td>
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<td>106.4</td>
<td>(29.9)</td>
<td>106.4</td>
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<td>226.8</td>
<td>231.6</td>
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<tr>
<td>90%</td>
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<tr>
<td>Sales Year 1</td>
<td>IRR (%)</td>
<td>Net Cash Flow</td>
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<td>125.8</td>
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<td>96.0</td>
<td>233.9</td>
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<td>331.7</td>
<td>336.5</td>
<td>341.3</td>
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<td>96.0</td>
<td>233.9</td>
<td>326.9</td>
<td>331.7</td>
<td>336.5</td>
<td>341.3</td>
<td>346.1</td>
<td>350.9</td>
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<td></td>
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<td>6. Impact of total initial equity on debt-equity ratio</td>
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</tr>
<tr>
<td>Equity</td>
<td>Debt-Equity Ratio</td>
<td>Net Cash Flow</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>4.0:1</td>
<td>26.3</td>
<td>-17.0</td>
<td>-10.3</td>
<td>-40.8</td>
<td>4.6</td>
<td>1.9</td>
<td>1.1</td>
<td>0.7</td>
<td>0.5</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>400</td>
<td>2.0:1</td>
<td>3.2</td>
<td>4.8</td>
<td>9.2</td>
<td>2.6</td>
<td>1.5</td>
<td>1.0</td>
<td>0.7</td>
<td>0.5</td>
<td>0.4</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>7. Changes in year 5 pre-tax profit with changes in: Recovery Rate &amp; Volume of Product Sold</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Recovery Rate &amp; Volume of Product Sold</td>
<td></td>
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<tr>
<td>Tons of Finished Product Sold</td>
<td>Selling Price of Finished Product</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$250</td>
<td>$275</td>
<td>$300</td>
<td>$325</td>
<td>$350</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>70%</td>
<td>(301.3)</td>
<td>-162.7</td>
<td>-24.1</td>
<td>114.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80%</td>
<td>(247.4)</td>
<td>-96.3</td>
<td>54.8</td>
<td>205.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>90%</td>
<td>(230.0)</td>
<td>-75.2</td>
<td>85.7</td>
<td>246.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recovery Rate &amp; Selling Price</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70%</td>
<td>(195.0)</td>
<td>(109.0)</td>
<td>(23.0)</td>
<td>(62.0)</td>
<td>148</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80%</td>
<td>(68.0)</td>
<td>29.0</td>
<td>127.0</td>
<td>225.0</td>
<td>323</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>90%</td>
<td>18.0</td>
<td>128.0</td>
<td>239.0</td>
<td>349.0</td>
<td>459</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
EFFECT OF RECOVERY RATE ON RATE OF RETURN. This enterprise is also sensitive to variations in recovery rate. The technical analysis must therefore include thorough research to determine the level of recovery rate that is realistic to expect in the circumstances under which the plant will operate. When the project gets underway, management will have to focus on sustaining the recovery rate by keeping equipment in good condition and workers trained, and by insisting on the proper quality of raw material purchases, perhaps with grade price differentials.

EFFECT OF SALES IN YEAR 1 ON RATE OF RETURN. If no raw materials were available in Year 1, first-year losses would increase from $205,600 to $416,000; profit in each subsequent year would be lower until the carry-over loan was paid off; and the overall return for the five-year period would be reduced from 18.8 percent to 16.1 percent. The effect would be even more dramatic (another $140,000 loss) if the plant had not been ready to process and sell the product, but nevertheless had to buy the crop because it had contracted to do so as an incentive to producers.

EFFECT OF TOTAL INITIAL EQUITY INJECTION ON DEBT-EQUITY RATIO. This test demonstrates the importance of being realistic about the amount of equity that will be needed to make the business successful. The base scenario was a $200,000 equity down payment on fixed assets plus $100,000 cash toward working capital for a total of $300,000. Using the reasonable assumption that access to credit will be virtually impossible if the debt-equity ratio exceeds 3:1, then even an extra $100,000 to bring initial equity up to $400,000 will not be enough for this business. Without access to enough capital, the firm would not be able to buy and process the volumes projected. Early losses would be bigger and longer, even if the business could survive. In the discussion of the balance sheet above, it was suggested that at least $250,000 extra was needed. Even that $550,000 total would leave no room for any contingencies, and would have to be considered the absolute minimum equity contribution.

CHANGES IN 1997 PRE-TAX PROFIT WITH VOLUME OF SALES AND RECOVERY RATE. The combined effect of changes in these two success factors after five years can be very significant. At full volume (4,000 tons) and a normal recovery rate (80 percent), profit for the year would be $127,540. If the volume is reduced by 1,000 tons and the recovery rate declines 10 percent, the loss for the year would be $82,911—a difference of $210,451.
CHANGES IN 1997 PRE-TAX PROFIT WITH PRICE OF PRODUCT SOLD AND RECOVERY RATE. This test shows a similar result to that of volume of sales and recovery rate. If a 10 percent decline in the recovery rate is combined with a $25 price and margin decline, a loss of $109,161 would occur that year—a difference of $236,701 less than the base case.

In summary, three important points emerge from the sensitivity tests in our example: (1) thorough research is essential to establish probable ranges of prices and volumes both for market demand and raw material supply, (2) the enterprise must have an equity and working capital cushion for contingencies, and (3) controllable factors must be tightly managed so the enterprise will be able to adjust to the impact of risk factors.

Interpreting the Results

Interpreting the results of the financial analysis is much more than comparing numbers to textbook investment criteria. Informed judgment is fundamental to correct interpretation, particularly with respect to the confidence the analyst places in the assumptions and coefficients used in the analysis, and the level of risk the investors are able and willing to accept.

If the coefficients are little more than rough guesses, and if the investors are risk-averse, then the investment decision might be based on the more pessimistic scenarios of the sensitivity analysis. If the coefficients are based on thorough research and realistic forecasts that minimize the risk of unforeseen contingencies, and if the investors have strong management skills plus adequate capital to place at risk, the decision may be based on the more optimistic scenarios.

Presenting the Case for Financing

Once they have completed the full financial analysis described in this section, the analyst and sponsors will have all of the information they need concerning the proposed investment itself to prepare a solicitation of equity (prospectus) or a loan application. However, prospective investors and lenders will need other information, which the sponsors should assemble before presenting the case for financing:

- The experience and financial strength of the sponsors.
• The experience and qualifications of the key managers proposed for the enterprise.
• The economic and regulatory environment in which the enterprise is to function.
• The experience of other enterprises in the sector.
• The terms under which participation is to be invited.

Lenders base their investment decision on three basic financial criteria, all of which have been addressed in the financial analysis:

1. **Repayment capacity**, as demonstrated by pro forma cash flow or change in financial position statements that show that debt-service requirements are manageable, including some room in the cash flow for contingencies.

2. **Risk-bearing ability**, as demonstrated by pro forma balance sheets that show an equity cushion sufficient for the risks associated with the particular business, in combination with other risk management measures such as formal insurance and the degree of production and marketing diversification.

3. **Returns**, as demonstrated by pro forma P&L statements showing profits over the long term, even if there are losses in early years.

In addition, the lender will need proof of the validity of estimates that went into the analysis (again, thorough research is essential to support realistic coefficients). The lender must be confident that the management team is capable of handling the challenges they face, and that the borrower will operate honestly and in good faith.

Sponsors can take several measures, in addition to thorough research and analysis, to improve the prospects of a favorable decision by lenders:

• Present the written application and supporting materials in the manner preferred by the lender.
• Organize supporting materials to facilitate the lender's review.
• Make written presentations attractive, coherent, and unambiguous.
• Determine the legal and regulatory requirements associated with the loan application and be prepared to demonstrate your ability to comply with those requirements.
• Have supporting documentation such as deeds, titles, permits, and resolutions available for inspection or assignment.
Appendix 1. Introduction to Basic Financial Statements

Three basic financial statements are used in business to track performance and assess financial soundness. These same three statements need to be projected into the future as part of the financial analysis of proposed projects.

**Profit and Loss Statement (Income Statement).** The profitability of an enterprise is the basic measure of its long-term sustainability.

**Statement of Changes in Financial Position (Cash-Flow Statement).** This statement is particularly important in the early years to determine cash requirements. It also facilitates the discounting of cash flows to determine internal rate of return (IRR) and net present value (NPV).

**Balance Sheet.** This statement indicates the equity position of the enterprise in relation to debt, and so is the basis of measures of financial risk-bearing ability.

*The Profit and Loss Statement: Quantifying Returns*

The fundamental purpose of the profit and loss (P&L) statement is to measure the period’s profitability by matching all revenues for the period with all costs for the period. The phrase “for the period” is important when trying to understand the P&L statement. Sales made during the year should be counted as revenue in that year, that is “accrued” in that year, whether or not the payment has been received. Similarly, expenses incurred during the year should be counted in that year, that is “accrued” in that year, regardless of whether the bill has actually been paid. The various adjustments required in this system of accrual accounting often confuse those trying to understand the P&L statement.

In Table 5.21, all the components of the P&L statement have been pulled together in an abbreviated standard presentation. In addition, some calculations of basic performance coefficients have been added.

In most actual P&L statements, comparable figures of the prior year are also presented for ease of reference in determining year-to-year progress of the business. The “percentage of sales” figures are often included for analysis purposes, helping to identify various cost and revenue ratios and areas where improvements can have the largest impact.
Table 5.21 Statement of Profit and Loss for the Year

<table>
<thead>
<tr>
<th>Item</th>
<th>Thousands of U.S. Dollars</th>
<th>Percentage of Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>1,200</td>
<td>100</td>
</tr>
<tr>
<td>Direct cost of sales</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchases (raw materials, supplies, etc.)</td>
<td>450</td>
<td></td>
</tr>
<tr>
<td>Other direct costs</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>Beginning inventory</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>750</td>
<td>63</td>
</tr>
<tr>
<td>Less: ending inventory</td>
<td>100</td>
<td>8</td>
</tr>
<tr>
<td>Direct cost of sales</td>
<td>650</td>
<td>54</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>550</td>
<td>46</td>
</tr>
<tr>
<td>Fixed costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed factory, administration and overhead expenses</td>
<td>390</td>
<td>33</td>
</tr>
<tr>
<td>Depreciation</td>
<td>50</td>
<td>4</td>
</tr>
<tr>
<td>General expense</td>
<td>440</td>
<td>37</td>
</tr>
<tr>
<td>Net income (loss)</td>
<td>110</td>
<td>9</td>
</tr>
</tbody>
</table>

The individual components of this statement are discussed in the following paragraphs.

Sales (U.S. dollars)

| Sales (net) | 1,200 |

This item records the principal revenue for the period. It should include all sales for the year regardless of when payment is received. Sales made this year but for which payment has not been received are counted as this year’s sales. By the same principle, payment received this year for sales made in a previous year are not included here. The value of sales for which the enterprise has been paid will show up on the balance sheet.
sheet as cash or a bank deposit; the value of sales for which payment has
not been received by the end of the year appear in the balance sheet as an
asset called "accounts receivable."

Sales may be presented in an income statement either as a gross figure,
from which returns and various discounts for volume or customer com-
plaints must be deducted, or as a net figure.

<table>
<thead>
<tr>
<th>Direct Cost of Sales (U.S. dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchases (raw materials, supplies, etc.)</td>
</tr>
<tr>
<td>Other direct costs</td>
</tr>
<tr>
<td>Beginning inventory</td>
</tr>
<tr>
<td>Subtotal</td>
</tr>
<tr>
<td>Less: ending inventory</td>
</tr>
<tr>
<td>Cost of sales</td>
</tr>
</tbody>
</table>

"Direct cost of sales" or "Direct cost of goods sold" represents
expenses that are tied directly to the volume of product sold in the year.
These costs are often referred to as "direct costs," and correspond to what
financial analysts and economists call "variable costs" or sometimes
"avoidable costs" (because they are avoidable in proportion with reduc-
tions in volume).3 Note again, that costs are counted in the year in which
they occur whether or not payment has been made. Any unpaid bills at
the end of the year will appear on the Balance Sheet as liabilities called
"accounts payable."

"Purchases" is the first cost-of-sales item. Obviously, raw material
purchases are directly tied to volumes of finished product produced, as
are such supplies as packaging and chemicals used in processing.

3. Readers with an interest in accounting will note that this definition implies se-
lecting the direct cost over the absorption cost method. Under direct costing, only
variable costs are regarded as product costs, while in the absorption costing meth-
od, fixed production costs are applied to products. The main reason for selecting
the contribution approach in this analysis is that separation of variable and fixed
costs will be essential in applying decisionmaking techniques such as break-even
analysis.
“Other direct costs” normally include services tied directly to production levels, such as wages and benefits of plant laborers who are called in to work only when there is product to be processed, and the cost of permanent workers that is directly related to production.

The two items “beginning inventory” and “ending inventory” are adjustments used to ensure that only the cost of goods sold during the period are charged to that period as “cost of sales.” Beginning inventory is acquired from the previous accounting period, and is available for sale just like goods produced during the period. Ending inventory represents the value of goods not sold, but transferred as an asset to the next accounting period for future sale. In this way, accountants ensure that costs are “matched” to the period in which the corresponding revenue is earned.

In the example, since this is the first year of operation, the beginning inventory is zero. The ending inventory value (100) reflects costs incurred this year in producing goods that were not sold but rather have become part of inventory for sale in future years. Note that inventory is valued at the cost of manufacture, not the expected sale price.

<table>
<thead>
<tr>
<th>Contribution Margin (U.S. dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
</tr>
<tr>
<td>Direct cost of sales</td>
</tr>
<tr>
<td>Contribution margin</td>
</tr>
</tbody>
</table>

Contribution margin, or merely “margin” is simply sales minus direct cost of sales. This calculation provides the analyst with one of the most important tools needed for assessing past performance and future viability. It is the basis for calculating break-even points (see discussion below).

4. It is important to note that contribution margin as defined here is not a synonym for gross profit margin, or gross profit. To calculate gross profit, the cost of sales must include fixed manufacturing costs. This absorption costing approach results in a more complete distribution of manufacturing costs among products and is therefore more useful as a cost control tool. However, the investment analyst is generally more concerned with the distinction between fixed and variable costs and will use the direct cost method and contribution margin.
and the impact on profitability of changes in sales levels, plus other measures of performance.

<table>
<thead>
<tr>
<th>Fixed Costs (U.S. dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed manufacturing, administration, and overhead expenses</td>
</tr>
<tr>
<td>Depreciation</td>
</tr>
<tr>
<td>Fixed costs</td>
</tr>
</tbody>
</table>

Fixed costs, also known as "general expense," record expenses that are incurred regardless of the volume of production and sales. Financial analysts and economists refer to these as "fixed costs" because they are not changeable in the short term regardless of product volume. Typical expenses included in this category are management and office salaries, general utilities, insurance, interest, and depreciation.

Depreciation is an expense that represents the share of the purchase cost of a durable asset that is charged to each accounting period in which that asset is expected to be productive. Although it is not a cash expense of the accounting year, it represents each year's share of capital costs matched against sales of that year.

A number of methods have been devised to calculate depreciation, including the "declining balance" and "sum-of-digits" approaches, but these variations have been developed in response to particular provisions of national tax regulations. For investment analysis purposes, analysts should use the standard straight-line depreciation schedule: The full cost of the asset divided by the number of years of useful life gives the annual depreciation charge.

When the equipment or facilities are leased rather than purchased, depreciation is not relevant. In its place, the cost of the respective equipment or facility is represented by the annual lease costs. Lease costs are assumed to be paid as long as the equipment is needed, with new equipment replacing old as the years progress. The cost of the new equipment is borne by the lessor, using profits and his own depreciation charges gained over the life of the lease.
Financial Analysis of Agroindustrial Investments

Net Income (Loss) (U.S. dollars)

<table>
<thead>
<tr>
<th>Sales</th>
<th>1,200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct cost of sales</td>
<td>650</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>550</td>
</tr>
<tr>
<td>Fixed costs</td>
<td>440</td>
</tr>
<tr>
<td>Net income (loss)</td>
<td>110</td>
</tr>
</tbody>
</table>

"Net income (loss)," or "profit (loss)," consists of revenues less direct costs (expressed as "gross profit margin") less "general expense." Note that the parentheses around the word "loss" also indicate that the figure will be placed in parentheses if it is negative.

Break-Even Estimation

"Break-even" sales are a quick rule-of-thumb estimate of the sales level needed to cover general expense at existing or other profit margins. Dividing the general expenses ($440,000 in the present example) by the percentage contribution margin (46 percent = 0.46) indicates the volume of sales needed to cover all costs but generate no profit ($956,522). The analyst can use this technique to examine the impact of different contribution margins on the volume of sales required to break even (see below). This and related volume-cost-profit rules of thumb are examined in more detail later.

(Fixed Costs = US$440,000)

<table>
<thead>
<tr>
<th>If Contribution Margin (%)</th>
<th>Sales Volume to Break Even (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>4,400,000</td>
</tr>
<tr>
<td>20</td>
<td>2,200,000</td>
</tr>
<tr>
<td>30</td>
<td>1,466,667</td>
</tr>
<tr>
<td>40</td>
<td>1,100,000</td>
</tr>
<tr>
<td>46</td>
<td>956,522</td>
</tr>
<tr>
<td>60</td>
<td>733,333</td>
</tr>
</tbody>
</table>
Cash Flow: Estimating Repayment Capacity

The Statement of Changes in Financial Position reports where funds were obtained during the year and how they were used. The statement has two main parts: sources and applications. The value received from all sources must be accounted for in applications; in other words, the totals of these two sections must be equal.

Financing activities are those that result in inflows of funds and are depicted in the sources section of the statement. It is divided into two main subsections: "sources from operations" and "other sources." Note that, under "sources from operations," depreciation is added back to net income because it is a noncash expense. "Other sources" of cash include equity (sale of shares) or increases in liabilities.

Investing activities are those that result in outflows of funds and are depicted in the applications section of the statement. Applications can include acquisition of assets, retirement of debt, and payment of dividends. Note that a subtotal is struck just before "Change in cash balance" in this section. This departure from normal presentation is used here to illustrate that (1) "change in cash balance" is actually net cash flow for the year; and (2) "change in cash balance" is a calculated residual amount in the pro forma statements used in the financial analysis of the proposed enterprise.

The "last year" column in Table 5.22 refers to the start-up year just before the first year of operation labeled as "this year." For simplicity, the "last year" start-up activity is assumed to have taken place on the last day of the year (avoiding complications such as operating revenues and expenses, depreciation, and principal payments): plant and equipment was purchased for $1,000,000, a term loan of $800,000 was received to help finance it, and shares were sold to raise a total of $300,000 to make the $200,000 down payment plus provide $100,000 cash to work with.

Activities of "this year" are based on the P&L statement that appears as Table 5.21.

The Balance Sheet: Determining Risk-Bearing Ability

The balance sheet is a snapshot of the financial condition of the enterprise at a given point in time. The statement is cumulative, presenting the net effect of all financial transactions from inception of the enterprise to the date of the statement. The balance sheet shows the value of the assets of
Table 5.22 Statement of Changes in Financial Position
(U.S. dollars)

<table>
<thead>
<tr>
<th>Sources of Funds</th>
<th>Last Year</th>
<th>This Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net profit (loss)</td>
<td>0</td>
<td>110,000</td>
</tr>
<tr>
<td>Plus noncash expenditure, depreciation</td>
<td>0</td>
<td>50,000</td>
</tr>
<tr>
<td>Funds from operations</td>
<td>0</td>
<td>160,000</td>
</tr>
<tr>
<td>Increased payables and operating loan</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Increase in term loans</td>
<td>800,000</td>
<td>0</td>
</tr>
<tr>
<td>Equity injection (e.g., share sale)</td>
<td>300,000</td>
<td>0</td>
</tr>
<tr>
<td>Funds from other sources</td>
<td>1,100,000</td>
<td>0</td>
</tr>
<tr>
<td>Total sources of funds</td>
<td>1,100,000</td>
<td>160,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Applications of funds</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in inventory</td>
<td>0</td>
<td>100,000</td>
</tr>
<tr>
<td>Increase in receivables</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total capital disbursements</td>
<td>1,000,000</td>
<td>0</td>
</tr>
<tr>
<td>Principal repayment</td>
<td>0</td>
<td>50,000</td>
</tr>
<tr>
<td>Dividends paid out</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Subtotal excluding change in cash balance</td>
<td>1,000,000</td>
<td>150,000</td>
</tr>
<tr>
<td>Change in cash balance</td>
<td>100,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Total applications of funds</td>
<td>1,100,000</td>
<td>160,000</td>
</tr>
<tr>
<td>Cumulative cash balance, year end</td>
<td>100,000</td>
<td>110,000</td>
</tr>
</tbody>
</table>

the enterprise and how these assets are financed. Assets are listed on the left side of the sheet, liabilities and equity on the right side. When balance sheets of several years are shown side by side for comparative purposes, the assets are listed at the top, followed by liabilities and equity.

The term "balance sheet" derives from the fact that the value of the assets must be equal to the sum of the values of liabilities and equity. The balance is not maintained by simply plugging in a residual value for equity. It occurs because every transaction affects offsetting items in the
balance sheet. For example, a $100 cash sale increases cash balance in current assets by $100 and reduces inventory in current assets by $54 (since the cost of sales is 54 percent of selling price in our example), for a net increase of $46 in current assets. At the same time, the $100 sale less the $54 cost of sales represents $46 in profits, which automatically increases equity via retained earnings by $46, keeping the balance sheet in balance. Every other transaction or financial event can be traced in a similar way through its impact on various components of the balance sheet, always keeping assets in balance with the sum of liabilities and equity.

**Current assets** are short-term assets that will normally be used up within a year. Primary examples are cash, receivables, and inventory. Cash and other current assets that are readily converted to cash are referred to as liquid assets.

**Fixed assets** are assets that normally have a useful life of more than one year. Primary examples are land, buildings, and equipment. They are valued at original cost less depreciation.

**Other assets** are long-term assets, although often they do not represent any physical item (in which case they are referred to as “intangible” assets. “Goodwill” in the form of something like a purchased franchising or licensing or marketing agreement may be included here. The value placed on such assets is original cost less depreciation. Another example would be capitalized expenses such as the cost of organizing the enterprise, which could be amortized over five to ten years.

**Current liabilities** are amounts owing that must be paid within a year. Payables and operating credit or overdraft are obvious examples. The current principal payments on term loans are also current liabilities.

**Term liabilities** are amounts owing that are scheduled to be paid more than one year into the future from the balance sheet date. The calculation of this amount is the total principal balance outstanding on term loans, less the payments scheduled to be paid in the coming year (these payments for the year are included in current liabilities as explained above).

**Shares** represent the equity contributed to the business by its owners in the form of the purchase of shares. By and large this consists of the purchase price of the shares although in practice some of these proceeds may appear as “contributed surplus.”

**Contributed surplus** refers to resources that can be generated by several types of transactions, although the treatment as contributed surplus can vary depending on corporate structure, type of industry, and generally accepted accounting principles (GAAP) in force in a particular jurisdic-
tion. For example, an outright grant from the government to the business may be treated as contributed surplus, or as "extraordinary income" that becomes equity via retained earnings. For purposes of financial analysis, it is better to treat such one-time or unusual payments as contributed surplus so as not to distort the picture of financial performance from operations, including the return on the actual investments made by the owners. Gifts, awards, and bequeathals may also be classified as contributed surplus.

*Retained earnings* represent all profits accumulated since the start of the business, less any that have been distributed to the owners of the business, usually in the form of dividend payments.

**Ratio Analysis**

**Balance Sheet Ratios.** A great deal can be learned about the condition of an enterprise by comparing various elements of the balance sheet with others in the form of ratios. These numbers have value in and of themselves, but they take on their greatest significance in the context of changes over time, or in comparison with competitors or industry norms. Table 5.24 shows several key balance sheet ratios calculated from Table 5.23.

**Debt-Equity Ratio.** This measure of the financial soundness of the business is simple to calculate: total liabilities divided by total equity equals debt-equity ratio. A high ratio means high risk. The example's "this year" debt-equity ratio is 750/410 = 1.83. This means that for every dollar the owners have put into or left in the business, $1.83 of debt is owed to outside creditors. Since the debt must be repaid on a fixed schedule, the higher the debt-equity ratio, the less sound the business in terms of its ability to withstand financial shocks.

The debt-equity ratio is monitored closely by commercial lenders as they make their risk assessment and credit decisions. In the event of business problems, an enterprise with a high debt-equity ratio has proportionately little of its own resources as a cushion, and a correspondingly higher debt-service burden. Its need for additional borrowed funds to finance operations during the difficult period will be in conflict with its credit worthiness as perceived by prospective lenders.
### Table 5.23 Balance Sheet (End of Period)

*(thousands of U.S. dollars)*

<table>
<thead>
<tr>
<th>Item</th>
<th>Last Year</th>
<th>This Year</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assets</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current (liquid, used within year)</td>
<td>100</td>
<td>210</td>
</tr>
<tr>
<td>Fixed (last more than year)</td>
<td>1,000</td>
<td>950</td>
</tr>
<tr>
<td>Other (goodwill, etc.)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total assets</strong></td>
<td>1,100</td>
<td>1,160</td>
</tr>
<tr>
<td><strong>Liabilities</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current (due within year)</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Term (due subsequent years)</td>
<td>750</td>
<td>750</td>
</tr>
<tr>
<td><strong>Total liabilities</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Equity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beginning retained earnings</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Plus profit (loss) for the year</td>
<td>0</td>
<td>110</td>
</tr>
<tr>
<td>Less dividends declared for the year</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>= ending retained earnings</td>
<td>0</td>
<td>110</td>
</tr>
<tr>
<td>Shares (proceeds from selling shares)</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Contributed surplus (various)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total equity</strong></td>
<td>300</td>
<td>410</td>
</tr>
<tr>
<td><strong>Total liabilities and equity</strong></td>
<td>1,100</td>
<td>1,160</td>
</tr>
</tbody>
</table>

### Table 5.24 Balance Sheet Ratios

<table>
<thead>
<tr>
<th>Ratio</th>
<th>Last Year</th>
<th>This Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt-equity ratio</td>
<td>2.67:1</td>
<td>1.83:1</td>
</tr>
<tr>
<td>Liabilities as percentage of assets</td>
<td>73</td>
<td>65</td>
</tr>
<tr>
<td>Current ratio (Current assets / current liabilities)</td>
<td>2.00</td>
<td>4.20</td>
</tr>
<tr>
<td>Working capital (current assets - current liabilities)^a</td>
<td>50</td>
<td>160</td>
</tr>
</tbody>
</table>

*a. Thousands of U.S. dollars.*
For firms with a proven track record in relatively stable industries, lenders consider a maximum debt-equity ratio to be approximately 3.00 or lower. New businesses in volatile industries such as agroindustry might have to keep their debt-equity ratio down to 2.00 or even 1.00. If our example enterprise had lost $100,000 in its first operating year (a more realistic result than the $110,000 profits projected), equity would have declined from $300,000 to $200,000, and the debt-equity ratio would have increased to 3.75 (750/200). To keep going until it becomes profitable, the enterprise would have to obtain more equity from its owners, find additional owners, or look for some form of guarantee with which to solicit favorable consideration by lenders.

**Liabilities as a Percentage of Assets.** This is another way of expressing the same measure of financial soundness as that conveyed by the debt-equity ratio. If this percentage is high, then risk is high. The calculation is total liabilities divided by total assets multiplied by 100. Since assets equal liabilities plus equity, this result could also be expressed as liabilities as a percentage of total capital.

**Current Ratio.** The current ratio is a measure of the firm's ability to meet its financial commitments in the short term. The calculation is current assets divided by current liabilities. A high ratio indicates that the firm would be better able to meet its commitments. At a minimum, this ratio must be maintained at 1.00, meaning that current assets such as inventory and receivables are just sufficient to pay off liabilities such as payables and operating credit and term loan payments due within the year.

Ideally, a ratio of at least 2.00 should be the target in relatively stable industries so that sufficient working capital is available for smooth business operations and to take advantage of profitable opportunities or to withstand temporary setbacks. When the current ratio is close to 1.00, the firm is strapped for cash and will be only able to buy raw material and other inputs as quickly as cash is received from sales. Such a cash constraint on operations becomes particularly severe in agroindustries where seasonal selling patterns do not correspond with seasonal cost peaks that
build as harvest approaches and do not abate until the whole crop is processed.\(^5\)

**Working Capital.** This is the dollar value of current assets minus current liabilities. Its financial implications are the same as those of the current ratio. When working capital is zero, the current ratio is 1.00 ($1.00 of current assets for every $1.00 of current liabilities).

**Profit and Loss Ratios**

Managers and investors are particularly interested in the earnings potential of the business. Three of the key ratios measuring operating results are presented in Table 5.25. Note that these ratios will normally be presented for at least one previous year for comparison with the current year.

<table>
<thead>
<tr>
<th>Ratio</th>
<th>Last Year</th>
<th>This Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return on sales</td>
<td>—</td>
<td>9%</td>
</tr>
<tr>
<td>Investment turnover</td>
<td>—</td>
<td>1.11</td>
</tr>
<tr>
<td>Return on investment</td>
<td>—</td>
<td>19%</td>
</tr>
<tr>
<td>Total assets</td>
<td>—</td>
<td>19%</td>
</tr>
<tr>
<td>Equity</td>
<td>—</td>
<td>37%</td>
</tr>
</tbody>
</table>

— Not available.

**Return on Sales**

This is a widely used index of profitability, calculated as net income ($110) divided by net sales ($1,200). This ratio has limited usefulness in investment selection because it does not take the size of investment into

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5. Recognizing that some current assets are not convertible to cash (e.g. prepaid expenses) and others may prove very difficult to liquidate (inventory), analysts have developed a more rigorous test of solvency: the quick-ratio or acid-test ratio: current assets minus inventory, minus prepaid expenses divided by current liabilities.
account. Following the example, the same return on sales would result if the value of the assets were $2,320 or $580 (double or half the value of the original assets figure) whereas the earnings potential of the business would not be considered equivalent in all three situations.

**Investment Turnover**

This ratio, computed by dividing net sales ($1,200) by average total assets for the year, measures the effectiveness with which management used the available resources to generate revenue. For ease of calculation, assume that asset changes occurred evenly throughout the year. Average assets are thus beginning assets, plus ending assets divided by 2. The shortcoming of this figure is that it does not consider expenses:

\[
\frac{1,200}{1,100 + 1,160} = \frac{1,200}{1,130} = 1.06
\]

**Return on Investment**

Probably the best-known ratio, return on investment, has the advantage of combining earnings and investment. Also discussed earlier in the chapter as a quick measure of viability, the ratio can be calculated on two different bases:

- **(Net Income + Interest)/Total Assets.** This measures the efficiency with which management used the total resources available to them.
- **Net Income/Beginning Equity.** This measures the residual return to the owners on their investment in the business.

The difference between these numbers (return on equity return on total assets) represents the leverage factor, or the effect of borrowing rather than additional investment by the owners.
Appendix 2. Net Present Value and Internal Rate of Return

Net Present Value

A dollar to be received in the future is worth less today than a dollar received today. "Net present value" is a measure of today's value of future receipts. To determine present value, the future receipts are "discounted" by a factor representing the opportunity cost of capital or a target rate of return, known as the "discount rate." This rate is determined somewhat arbitrarily, but to arrive at a rate with which they are comfortable, investors will use indicators such as the rate on high-grade bonds, their cost of borrowing funds, their own assessment of risk, and their alternative investment opportunities. The term "net" alludes to the fact that future cash outflows are deducted from future inflows before the discounting is performed.

As an example of the NPV concept, consider the following case. A business acquaintance comes to you and says he needs some cash now and will pay you a total of $10,000.00 two years from now. How much cash would you give him now in return for that future receipt?

- The first consideration is the possible return if you invested your money elsewhere. If safe investments such as government bonds and bank term deposits are paying 8 percent, then you know you have to realize at least 8 percent return on your money.
- If your own business is already borrowing money at 10 percent, then you know you have to realize at least 10 percent to keep from losing money.
- If you can earn 12 percent on money invested in your own business, you would have to earn at least that 12 percent on money you lend to your business acquaintance. Let us say that lending to your acquaintance carries no more risk than investing further in your own business.

In this manner, you arrive at the conclusion that your "opportunity cost of capital" or "discount rate" is 12 percent. You can approximate the answer to the question "How much cash would I have to invest elsewhere to get that same future receipt?" by applying that 12 percent "opportunity cost of capital" against that future receipt.
### Net Present Value of US$10,000 Received after Two Years

<table>
<thead>
<tr>
<th>Receipt at end of year 2</th>
<th>$10,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less 12% discount (divide by 1.12)</td>
<td>(1,071)</td>
</tr>
<tr>
<td>Value at end of year 1</td>
<td>$8,929</td>
</tr>
<tr>
<td>Less 12% discount (divide by 1.12)</td>
<td>($957)</td>
</tr>
<tr>
<td>Value today of $10,000 received at end of 2 years</td>
<td>$7,972</td>
</tr>
</tbody>
</table>

The above example illustrates the principles of discounting a future receipt backward over the number of periods from the time it is received to now. Note that we do not simply deduct 12 percent from the value at the end of the period. Recall that our rationale is a particular return on an investment made at the beginning of the period, in this case 12 percent. Consequently, the value at the end of the period is 112 percent of the beginning value, and we determine the beginning value by dividing the end value by 1.12.

As an investor, you would be willing to pay approximately $7,972 for an investment that returns $10,000 at the end of two years. If $7,972 is exactly what the business colleague is willing to accept in return for paying you $10,000 in two years, then you are indifferent as to whether you invest in a loan to him or in the alternative investment you used as a comparison (in this case, your own business). The present value of your future receipt is $7,972, and the present value of your $7,972 cash outlay or investment cost today is $7,972 (the outlay is a negative receipt, and since it is made today there is no time over which it must be discounted). The net present value, when the two values are combined, is zero.

An NPV of zero indicates that you would be just as happy either lending to this business acquaintance borrower or investing the money in your other alternative.

If the prospective borrower is willing to accept only $7,500 cash now in return for his payment of $10,000 to you in two years, there would be a positive NPV of $472, and you would be better off to make the loan: present value of receipts ($7,972) less present value of outlays ($7,500).

By similar reasoning, if the prospective borrower wants $8,000 in return for his payment of $10,000 to you in two years, the NPV of the loan investment would be negative ($7,972—$8,000), and you would not make the loan.
In summary, if the NPV at the opportunity cost of capital is positive, the investment is attractive. If NPV is zero, it is still a good investment but no better than the alternatives used for comparison. If the NPV is negative, the investment is not as good as other alternatives.

**Internal Rate of Return**

Internal rate of return analysis is closely related to NPV. In fact, the IRR is the discount rate that results in NPV being equal to zero.

- Net present value analysis specifies the target rate of return as a discount rate, then determines whether that rate is achieved under the investment by seeing whether the NPV is zero or greater.
- Internal rate of return analysis calculates the rate of return actually achieved; then the decisionmaker compares that rate with the target rate of return.

To assess the merit of a particular investment, its internal rate of return will be compared with that of other investment opportunities. Unlike the NPV measurement, the IRR value is not related to size of investment, so it can be used to compare alternatives of different size. In addition, it can be compared to the investor’s opportunity cost of capital or a minimum rate of return that represents an investment criterion. The internal rate of return must exceed that level if the investment is to appeal to the investor.
Managing the Agroindustrial Enterprise

At the development stage of a venture, those who are deciding whether to create the enterprise are also making strategic decisions about the management, ownership, and organization of that enterprise. In fact, ownership and organization are tools the sponsors can use to shape their corporate and business strategy. Management is examined in this broad sense in this chapter.

The management concerns of an agroindustrial enterprise are similar to those of any other commercial enterprise. For any given market opportunity, the types of choices that have to be made are governed by the legal and economic systems in effect in the country of operations, the institutional and infrastructure setting in which the enterprise operates, the socioeconomic factors affecting group and individual behavior, and resource constraints such as scarce capital or skilled labor.

However, the peculiar traits of agroindustries make it necessary to attach different weights to decision factors and to the many variables to be considered in institutional design. Therefore, as in the case of financial analysis, the agroindustrial planner will often reach conclusions that reflect the peculiar nature of agroindustrial operations.

A Framework for Management Design

The management components of an enterprise can be divided into two types: the systems that are put in place for management, and the decisions and action taken within those systems. At the design stage, the ana-
lyst is principally concerned with the systems to be installed. However, the quality of subsequent decisions and action will be a function of the competence of incumbent managers, and the systems must therefore include management selection and development, as well as compensation and reward.

**Management Systems**¹

- Organization and structure
- Information and decision systems
- Planning systems
- Measurement and control systems
- Management selection and development
- Reward systems.

A commercial or industrial enterprise performs a number of basic functions that are independent of its special activity. These consist of caring for the corporate entity itself and business functions:

**Enterprise Functions**

- Corporate
- Business
  - Marketing
  - Production
  - Procurement
  - Finance
  - Personnel
  - Research and development.

A matrix of these management systems and enterprise functions gives the analyst a means of examining the adequacy, consistency, and interdependence of the systems to be established. Some management systems will be unique to individual functions of the enterprise; others will govern, or be uniform for, the entire legal entity. (For discussion purposes, we shall refer to this entity as a corporation.)

This chapter concentrates on four management systems that are common to the corporation as a whole: organization and structure, information and decision systems, planning systems, and measurement and control systems.

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tion and decision systems, planning systems, and measurement and control systems. The development and compensation of a firm's human resources are as vital to its success as the choice of technology or the marketing strategy, but these are culture-specific aspects of management to which a great deal of specialized work has been devoted in other publications. The chapter concludes with a discussion of two specialized means of acquiring know-how: technology transfer agreements, and management contracts.

Organization and Structure

The organization and structure of an enterprise are defined by its legal form, ownership, scope of activities, and internal organization.

Legal Form

The legal system existing in the proposed country of operations will determine the forms a private enterprise can take. Specific rights and obligations vary, but most countries recognize three basic forms: two of these, the sole proprietorship and the partnership, represent extensions of the rights and obligations of the owners as individuals; the third, the corporation, represents a legal entity in and of itself.

The legal form most suited to agroindustrial enterprises under most circumstances is the common stock corporation—a type of independent legal entity in which power is shared by owners in proportion to their equity participation. This form of organization offers flexibility in mandate and capital structure; it has a legal existence independent of its owners, and therefore can exist in perpetuity; and it offers limited liability to its owners. This chapter is based on the assumption that the proposed enterprise will be established as such a corporation.

Whereas privately owned enterprises must take one of the three legal forms referred to above, governments can and do engage in commercial enterprise in a variety of legal forms, from departments to semiautonomous authorities and state-owned corporations. Experience with government-owned and operated agroindustrial enterprises has generally been poor, and there is a widespread trend now toward privatization of the management or ownership of such enterprises, or both. The alternative legal forms or other management elements of public enterprises are not addressed in this chapter.
A NOTE ON COOPERATIVES. Firms that have developed from the association of agricultural producers often operate as cooperatives. This is a form of corporation in which all owners have the same share of equity and equal voting rights, unlike the more common form of corporation in which the share of equity held by individual owners can vary, and their power is proportionate to their respective share of equity.

Another feature of cooperatives may be worthy of consideration if raw material suppliers are to play an important role in the company's operations: Profits of cooperatives are usually distributed in relation to patronage—in this case the supply of raw material. The company can ensure that its raw material costs are related to profitability by setting initial purchase prices at modest levels while holding supplier interest with the prospect of a second payment in the form of a dividend, based on market conditions and company performance. Although split payments are also possible with other forms of organization, they require separate administration as an operating cost, independent of the treatment of income.

Because they tend to be perceived by public institutions and development agencies as a more equitable form of economic venture, cooperatives occasionally enjoy special privileges such as access to capital on concessional terms, technical assistance, or market protection. The existence of any of these opportunities would make it worthwhile to consider this form of corporation.

On the negative side, the equity structure of cooperatives can be a drawback when a consensus is needed and the interests of producer-owners and those of the postharvest enterprise are not clearly harmonious. Bear in mind that the well-being of the postharvest enterprise is only one of the many interests of a producer-owner, particularly in areas of mixed agriculture and off-farm employment. Furthermore, because there are a large number of owners in a typical cooperative, their active participation will be limited, but authority will only be delegated to managers with respect to routine issues within business plans that are approved annually by the members. Consequently, cooperatives are often slow to respond to unusual events or conditions. Decisionmaking can also be drawn out, and decisions will tend toward compromise positions that represent the interests of the greatest number of members.

Another limitation of cooperatives where agroindustrial activities are concerned again relates to their equity structure. With power uniformly distributed among all owners, it is difficult for cooperatives to attract
equity participation by large entities that could add technology, capital, markets, or influence to the combined strengths of the owners. Such prospective participants are not inclined to risk greater contributions to an enterprise without a greater share in its decisions. Cooperatives must therefore solicit the participation of large partners under contractual arrangements. These tend to exclude risk sharing by the supplier and fixed costs, at the expense of the cooperative. They can have a detrimental impact on the debt-equity ratio of the enterprise, thereby reducing its capacity to raise debt capital.

Ownership

The sponsors of an investment proposal "own" the idea they are espousing. Their instinct will be to guard that ownership, to avoid diluting their interest by bringing other participants into the enterprise as owners. In many cases, however, it will be either necessary or desirable to attract other equity participation because this would bring useful relationships, resources, or know-how to the firm. To address the question of ownership, therefore, we must have a clear idea of the needs of the enterprise and an understanding of the alternative arrangements by which these needs can be met.

IDENTIFYING PARTICIPANTS FOR THE ENTERPRISE. The feasibility study for the proposed enterprise will have identified the markets, production capacity, supplies, capital, management, and technology that it needs. Individuals or organizations can provide one or more of these elements. In the first instance, we are looking for useful participants, without implying that they should become shareholders. The question of the form of participation should be addressed separately.

- Markets. Are there individuals or corporate entities that represent either a large share of the target market or a principal intermediary serving that market? Would participation secure that outlet for the enterprise? Could the competitive position of the enterprise be strengthened by attracting a competitor into the proposed venture? This will normally be associated with acquisition, merger, or negotiated agreements on future product and market restrictions for each entity.
• Suppliers. Is the market for raw materials and other supplies stable, with many suppliers? Are there uncertainties that could be reduced by involving critical suppliers in the enterprise?
• Productive assets. Land, buildings, machinery, and other chattels will be essential to the enterprise, and specific assets such as an ideal factory site or a low-cost reconditioned plant may represent a considerable advantage to business prospects. How can these assets be brought into the firm on the most favorable terms?
• Capital. What are the capital requirements of the enterprise? What limits are placed on the forms of capital by such factors as the weighted average cost of capital, debt-equity limits imposed by prospective lenders, prudent interpretation of financial projections with respect to debt service, and the terms and conditions offered by prospective equity and debt participants.
• Technology. Can the cost of technology be fixed or reduced by the formal participation of its supplier in the enterprise? Can participation be used to improve support services, continuity of information, training, and access to future developments?
• Management. Particularly in the early stages of a new enterprise, few sponsors will have the requisite management skills and capacity. Can the supply of these be ensured by the participation of competent managers in the enterprise? Will these external sources be effective in the institutional and cultural setting of the enterprise? Are management needs such that they should be met by the source of another input as well, such as technology or capital?

Determining the Form of Participation. Anyone who sells to, lends to, buys from, or works for an enterprise can be said to be a participant. However, in the context of management and strategic planning, the analyst is concerned with contractual participation because it is specifically defined, is more certain, and represents rights and obligations on the part of both the enterprise and the participant. There are basically three forms of contractual participation: the purchase of shares, the entry into one of many types of loan agreement, and contracts covering specific goods or services. Some of the features of each type are summarized in Table 6.1.

The form and extent of participation will in fact become a matter of negotiation, but the sponsors need to develop a sense of which participants they wish to become owners and thus share in the risk and profit.
Table 6.1 Features of Different Forms of Participation

<table>
<thead>
<tr>
<th>Factor</th>
<th>Equity</th>
<th>Loan</th>
<th>Other Contracts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost to the enterprise</td>
<td>Related to profits</td>
<td>Fixed</td>
<td>Predetermined</td>
</tr>
<tr>
<td>Dilution of ownership</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Type of commitment</td>
<td>General</td>
<td>Specific</td>
<td>Specific</td>
</tr>
<tr>
<td>Participates in management</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Affects capital structure</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Risk to participant</td>
<td>Full</td>
<td>Limited</td>
<td>Limited</td>
</tr>
</tbody>
</table>

Thought can also be given to flexible forms of participation such as convertible bonds, warrants, preferred shares, and contracts that include equity as part of the compensation package. These options provide for the phasing of participation decisions, thus giving the enterprise a period of time to become established and the parties time to become acquainted with one another before long-term decisions are taken.

However, sponsors do not have full latitude in negotiating the form of participation in one important respect: its impact on capital structure. All prospective owners, creditors and clients will be concerned about capital structure, and they will assess the initial strength of the enterprise, at least in part, on the basis of two questions: (1) Is the enterprise adequately funded in total? and (2) Is the equity base adequate for the size and type of enterprise? So, when sponsors are considering the question of ownership, they must keep in mind not only the total capital requirement of the venture, but the projections of two financial indicators: debt-equity ratio and debt-service ratio.

As illustrated in Chapter 5, broad financial swings can occur in agroindustrial operations, and it is important to have reserves to meet seasonal and unexpected deficits. This characteristic of agroindustries argues for a larger equity base, but note that this can be provided by larger contributions from a small core of shareholders rather than by diluting ownership through broader participation.
Table 6.2 Evolution of Business Strategy with Market Maturity

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Embryonic</th>
<th>Growth</th>
<th>Mature</th>
<th>Aging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop initial market</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market penetration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>Improve administrative productivity</td>
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<td>Abandon units</td>
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<td>Change managerial system</td>
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Note: Lines represent appropriate time frame for strategy.
Source: Adapted from Aillio, *The Practical Strategist*. 
Scope of Activities

This section is concerned with the balance of what the enterprise does itself, what the enterprise purchases through advanced contracts, and what it purchases in the open market. This is a question of the degree of integration of the enterprise.

If the decision factor were exclusively risk reduction, the agroindustrial enterprise would move toward full integration from raw material production to final sales, so as to control the maximum number of variables in its business performance—such as quality of raw material, efficiency of storage and transport, and level of marketing effort. However, the sponsors will also be faced with a resource constraint, questions of comparative advantage, the need to limit the range of activities and skills to be managed, and other factors that will lead them to decide to limit the scope of activities and to buy a share of their critical goods and services.

Determining the scope of activities is a fundamental part of business strategy, and the appropriate decision will depend on factors such as the age of the enterprise and the stage of its markets in the product cycle. Table 6.2 presents typical strategies at different stages in the life of enterprises and products. Note the shift in scope of activities during the cycle.

Business Strategy and Market Maturity

The stages of a market or product cycle vary in duration, both individually and in relation to each other. Staples have relatively long and stable market cycles. In contrast, products that appeal to current consumer interests, or that are the outcome of a rapidly changing technology have shorter and more pronounced cycles.

The business strategy should evolve with market maturity and in many respects will depend on the scope of activities. In the early stages, the basic strategy will be concerned with expansion; during middle stages, the focus should be on efficiency and segmentation; and finally, in the later stages, the strategy should be one of consolidation.

In general, the appropriate initial scope of activities can be determined in five steps:

Step 1. Identify the core activity of the enterprise. What niche does the enterprise fit into? What is its comparative advantage? For example, is it a farming enterprise that wishes to...
into processing and marketing? Is it a marketing company that wishes to secure its sources of supply? Is it a processor trying to diversify its product line?

Step 2. Identify the additional activities, goods, and services that are essential to the successful conduct of the proposed business. These could include raw materials, utilities, other inputs, technology and capital equipment, transport and storage facilities, market distribution channels, retail services, financial services, administrative services.

Step 3. Group these activities, goods, and services according to their common characteristics. Characteristics that will influence manageability, efficiency, or other decision factors include geographic proximity, similarity of management issues, common technology, common raw material or other input pattern, common core function (such as canning, trucking, banking), and overall level of resource and management requirements.

Step 4. Identify alternative means of securing the required goods and services. Some services such as transportation, and goods such as packaging materials, are readily available from specialized markets. Others may be peculiar to a few enterprises, or for other reasons may not be dependably available in the market. In such cases, long-term contracts may be an option for some, whereas others simply cannot be purchased and therefore must become part of the scope of activities of the enterprise.

Step 5. Develop the scope of activities on the basis of complementary groups up to the resource and management constraint. At the outset, a firm may decide to concentrate on processing and to buy its inputs in the open market and sell its outputs to exporters. As resources and experience increase, the firm may wish to reduce the uncertainty of its raw material supplies by going into production, or it may wish to increase its share of final product price by going into distribution and financial services.

Internal Organization

As in other aspects of organization and structure, effective decisions cannot be made concerning internal organization without a clear sense of the objectives of the organization. The objectives, or "goals," serve a number
of purposes:² provide an orientation for the enterprise by describing the future state of affairs to which it aspires; set down guidelines for the organization; provide a sense of purpose, a "raison d'être," for the organization; and serve as standards by which the performance of the enterprise can be measured.

Once the goals have been clearly articulated, the analyst is in a position to address the question of internal organization. Inasmuch as organization is a means of pursuing the objectives of the enterprise, organizational alternatives can be evaluated by the performance of the enterprise in pursuit of its goals—that is, by its effectiveness, or the degree to which goals are realized; and, by its efficiency, or the resources required to achieve a given level of output in relation to its goals.

Classical organization theory holds that the division of labor is essential to efficiency. By breaking tasks into simple, standardized components and organizing enterprise resources around these activities, managers achieve least-cost output. The assembly line is the ultimate example of this practice, and organizations may also be made up of units that pass product from one to the other like stations on an assembly line. The corollary of division of labor is unity of control. Each manageable group of subordinates (the span of control) is responsible to only one supervisor. In this way the organization becomes a pyramid of control.

In the past 20 years, technological developments in the workplace and changing education and social characteristics in the labor force have caused businesses to rethink these principles, and to reintroduce a degree of diversity and independence into the work at each level of the organization. However, the classical structures are still the basic building blocks from which the hybrids and modifications originate, and it is useful to start with them at the design stage.

CLASSICAL BUILDING BLOCKS. The activities of an enterprise can be organized along several lines of specialization.

Division by purpose. In this form, organizational units are established for each purpose or goal of the enterprise. For example, an enterprise operating in a rural area could have a developmental purpose, for which a separate department would be established combining technical, finan-

cial, and social support for the rural community, and from which raw material and labor are to be drawn. If an enterprise is aiming for efficient production, it might group all technical and financial support services into the production department; or if it is hoping to double its market share and diversify clientele in a particular market, it might have to establish a strong marketing department with direct control of support services such as credit, banking, warehousing, and distribution.

**Division by process.** Here, the activity or discipline governs internal organization. Engineers, technical personnel, and related support staff, for example, could form a processing department, while the financial and personnel services they need would be provided by departments specialized in each of these processes. In marketing, sales activities would be grouped together, but these could be separate from warehousing and distribution. In a fully integrated enterprise, agricultural production would, of course, be a separate unit.

**Division by type of clientele.** Those serving a particular set of customers would be organized into a single unit. For example, the Retail Sales Department would be distinct from the Wholesale and Institutional Sales Department. Processing and support activities for these different clients might even be grouped along the same lines, although this would be unusual in agroindustries. A common example of this form of organization appears in the multiproduct enterprises: Organization takes place along product lines, which are proxies for different clients.

**Division by geographical area.** In this form, geographic proximity is considered to be the most important common factor among tasks and resource groups. Regional departments combining different purposes, processes and clientele are typical of this form. A large farm machinery distributor is a good example, with its regional entities having the resources and authority to undertake virtually all of the company’s activities except manufacturing.

In practice, it is usually appropriate to combine more than one type of division within the corporation. For example, it is common for clientele and area to be the guiding principles at lower levels of the organization, while purpose or process typically dictate structure at the vice-presidential or other strategic levels.

**Recognizing interaction and resource constraints.** Simply dividing resources according to specialization of labor in the classical style does not address the critical question of how things will actually
happen within and among units. Consequently, many years ago organi-
zation and management specialists began incorporating processes and
values into their designs to reflect the human reality of organizations.
Five such factors are particularly important:3

**Accountability.** For the most part, accountability can be built into the
hierarchy of the organization, but as organizations increase in size or
sophistication, special units may be required. For example, a controller's
department should assume centralized responsibility for the accounting
systems and financial control of the enterprise. Quality control and secu-
rity are examples of other functions that will require special units to
ensure proper performance and accountability, even in moderately sized
organizations.

**Expertness and economy.** Some skills and functions will be essential to
an enterprise even though the demand is not large enough in individual
units to justify the presence of full-time specialists. For example, research
and development will normally be set up as a single unit, serving the
interests of different product and clientele units of the corporation. Com-
puter programming and support services should be consolidated for the
same reasons, and financial management skills are such that credit and
collections may go hand in hand in a single unit with investments and
financial management. Mechanical and electrical services will normally
be placed in a single unit, even though the skilled staff and equipment
will be needed to support a number of production and service units.

**Level of conflict settlement.** The internal organization should always
provide one point of authority to which any two or more units or individ-
uals can go to settle disputes or otherwise obtain authoritative decisions.
Setting this point at a relatively low level in the organization tends to give
faster decisions, reduces the workload of senior managers, and usually
means that the authority has a good knowledge of the facts and personal
circumstances with which to make sound decisions. But conflict can be
the stimulus for revising strategy or practices, and should therefore be
allowed to reach levels where these strategic issues are addressed. One
approach is to place the authority for resolving conflicts at the level of
immediate supervisors, but to establish a routine review process whereby
more senior managers are exposed to the pattern and types of conflicts.

3. H. A. Simon, D. W. Smithburg, and V. A. Thompson, *Public Administration*
Such a review should be independent of an appeals process, which should be in place in any event.

Program emphasis. Enterprises, like all organizations, tend to replace their service and performance goals with internal objectives; meeting budgetary targets becomes more important than achieving what the budget was intended to achieve, for example. The volume of throughput, because it is measurable and understood by all, may replace quality of throughput as evidenced by sales volumes, prices, and rejection levels. The internal organization can discourage this tendency by placing more power and emphasis with units directly engaged in the service and performance goals of the enterprise.

Centralization and decentralization. How far down the organizational hierarchy should decisionmaking authority be delegated? The tradeoffs are similar in some respects to those of conflict resolution, with speed and factual knowledge improving in proportion to the degree of delegation, and institutional perspective being better at more senior levels. Specialized units in an enterprise—for example, computer services, quality control laboratories, or credit departments—will tip the design toward centralization because many decisions will depend on inputs from these units. On the other hand, wide geographic distribution or diverse products or markets will call for more decisionmaking power at lower levels.

The matrix organization. Designing the internal organization of an enterprise is a process of balancing competing or conflicting factors. Different structures and authority systems are combined into a matrix in which mandates and lines of authority depend on the given task. For example, the operating units of the enterprise may be organized along the lines of purpose or area (Production, Marketing, Region A, Region B...), but special units to ensure expertise and economy will be set up on functional lines (Controllers, Research and Development, Engineering...), and these functional units will have counterpart staff within the operating units.

These line and staff functions, as they are called, are readily distinguishable at the level of the unit or goal; staff within the line units will be responsible to their immediate supervisors with respect to purpose and administration, but will be responsible technically or professionally to the respective specialized unit. However, at the level of day-to-day tasks and in the activities of individual employees, the distinction between line and staff can become vague. The effectiveness of the matrix will depend on
how clear the lines of responsibility are at this day-to-day level. Several steps can be taken to achieve this clarity:

**Ensure that targets and performance standards are clearly set out.** This should be done at the level of individual tasks and employees. Rank tasks by relative importance directly, for example, by setting schedules and priorities for the delivery of operational outputs (tons processed, orders filled...) and the performance of function tasks (samples tested, accounts sent to Controller's...).

**Establish procedures for addressing conflict between line and staff objectives.** For example, if the Processing Department gets behind in its functional tasks, does it reassign personnel, use overtime, or hire short-term help? If the price of a particular packaging material suddenly increases, does the processing department shift the product mix so as to stay within budget, or does the Controller's Department make midterm adjustments in the overall budget to provide the additional funds to the Processing Department?

**Ensure that appropriate information is available to responsible supervisors on which to assess performance and base decisions.** Also ensure that the basis of these assessments and the decisions by line or staff supervisors are understood by their counterparts.

**Establish an agreed process for review and for the resolution of disputes.** The classical principle of unity of command should apply to line and staff relations, as well as among line units. To whom do personnel or supervisors appeal when the clarity of objectives or the statement of priorities breaks down? Remember that these conflicts may signal important problems or opportunities for the enterprise, so make sure that they are at least reviewed periodically by senior managers.

**Basic steps in organization design.** To reiterate, the quality of a particular organizational design can only be judged in relation to the goals of the organization and the efficiency and effectiveness with which the structure permits an enterprise to pursue those goals. The point of departure must therefore be an operationally oriented statement of goals. Then, the designer or analyst can proceed with the following steps:

Step 1. (a) Select from among the division options—purpose, process, clientele, and area—for units at the operations level of the enterprise, and assign each unit a title. (b) Select from among these
division options for the units of the enterprise at the corporate level and assign each unit a title.

Step 2. Identify required expertise or small-quantity skills that should be grouped in special units, and assign each unit a title.

Step 3. Define unit functions in relation to the goals of the enterprise and develop initial measures of performance.

Step 4. Identify the types of decisions that will affect the work of each unit.

Step 5. Establish hierarchy and accountability relationships among the units.

Step 6. Establish the ideal decision authority for each unit.

Step 7. (a) Adjust decision authority among units to accommodate any skill or management constraint or exceptional circumstances such as start-up. (b) Define training needs, support services, or other developments required to move toward optimal distribution of decision authority.

Step 8. Establish a process for periodically reviewing unit performance, resolving conflicts, and making other nonroutine management decisions.

Information and Decision Systems

Information has several uses in the context of development projects, once goals have been set. These can be adapted for agroindustrial enterprises as follows:

1. To monitor physical and financial progress.
2. To examine the behavior of customers, competitors, and suppliers in relation to the activities of the enterprise.
3. To study specific operational problems.
4. To assess the socioeconomic impact of the enterprise, its compliance with regulations and community norms, and its relations with external groups and entities.

5. To make changes in goals or operations to improve performance with respect to (1) through (4).

Periodically, information is also necessary to determine and reassess the goals of the enterprise. A clear statement of these goals is the point of departure for developing the performance and problem-solving information system.

**A NOTE ON QUALITATIVE REPORTS.** While most formal information that moves through the enterprise will be quantitative—that is, numeric—at times it will be important to collect and interpret qualitative information, "descriptions of situations, events, people, interactions, and observed behavior." Qualitative reports will be verbal rather than numeric, and their design, frequency, and origin will be unique to the enterprise. They may be more costly to produce because they should consist of the perceptions and interpretations of authors with related experience. These factors indicate that qualitative reports will not have to be prepared as often; they should be used to examine specific problems or opportunities; and they should normally be assigned to staff units or to relatively senior levels of management.

**Basic Information Systems**

Each enterprise will have its own information needs, and these will change over time. But most agroindustrial enterprises need certain types of basic physical and financial information, which can be obtained from several sources, as summarized earlier.

An information system can be designed to meet these needs in the following steps:

Step 1. State each goal of the enterprise in operational terms. For example, rather than "increase business volume," use "increase sales

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of product X and Y by 20 percent," or "maintain production volume at not less than 75 percent of rated capacity."

Step 2. Identify the activities and units through which each goal will be pursued. For example, sales growth will be pursued principally through the Marketing Department; reduced energy costs will be pursued through the Production and Engineering Departments; the Procurement or Agriculture Departments will be responsible for maintaining an adequate flow of raw material for production objectives.

Step 3. Define the measures of performance to be monitored. Identify quantifiable indicators such as units sold, orders filled, tons purchased, percent shrinkage, unit costs, time per task or unit, downtime, and attendance. (Steps 1 through 3 should be incorporated into the budget of the enterprise.)

Step 4. Identify the sources of data for measurement. Ideally, these will be documents needed for other purposes, such as source documents for accounting and financial control, or multipurpose reports, so as to keep the cost of data collection to a minimum. But also ensure the accuracy and timeliness of the source material; if it is secondhand, as production figures from the accounting department usually are, verify that it is consistently accurate before adopting it as the source.

Step 5. Assign responsibility for reporting. Normally, this task will fall to the head of the unit responsible for the given activity. Assign adequate resources to permit proper data collection, analysis, and report preparation. Specialized staff units may be appropriate sources of information concerning operational activities if a cross-check on the line unit is needed, or if specialized skills are required for the reporting. For example, while the Production Department will report on physical production performance, the Accounting Department will report on production costs.

Step 6. Determine the form and content of reports. In most cases, different levels of management will be interested in different levels of information on the same subjects. Consequently, the efficient approach is usually to design the basic report to satisfy the most
detailed needs of the immediate supervisors or staff units, and then develop one or more summaries to meet other needs.

Step 7. Determine the frequency of reports. This will depend primarily on two factors: the speed with which conditions or performance change with respect to the item being measured, and the speed with which managers can or should adjust operations in response to the information being reported.

Step 8. Determine the distribution of reports. Deciding on distribution within the hierarchy of the reporting unit is simply a matter of detail and frequency, as all senior line managers have a share of operational responsibility for the activity being reported. In addition, specify what staff units need the information for their activities (sales reports from Marketing should go to Finance to permit projections of revenue), and what other operating units will be affected by the activity being reported (Processing should know if the Procurement Department expects a drop in raw material arrivals).

This information must be accurate and those whose performance is being reported should confirm that the data and analysis are valid. Therefore, both users and those being reported on must be consulted during the above steps. The consultations should focus on two issues: the design and content of the reports, and the manner in which they are to be used. There are limits to the feasibility of this consultation, related in part to work and social norms, but the analyst must be aware of the benefits of consultation to the extent possible.

Information systems often take on a life of their own and begin to demand more resources and produce and circulate more and more reports without regard to the actual use made of this output. To discourage this tendency, there should be regular reviews of information flows in the enterprise, and both the producers of information and the users should be asked to relate their sense of the usefulness of the information not simply to the goals of the enterprise, but to the conduct of their particular activities in the pursuit of those goals.
### Table 6.3 Basic Information on Physical Performance of an Agroindustry

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<tr>
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<th>Report</th>
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<td>Deliveries</td>
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<td>Warehouse logs</td>
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<td>Condition</td>
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<td>Shrinkage</td>
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<td>Location</td>
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<td>Quality</td>
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<td>Downtime</td>
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Table 6.4 Basic Information on Financial Performance of an Agroindustry

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<td>Cost of operations(^a)</td>
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<tr>
<td><strong>Stocks</strong></td>
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<td>Warehouse logs</td>
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<td></td>
<td>Cost of operations</td>
<td>Expense reports</td>
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<tr>
<td><strong>Distribution</strong></td>
<td>Cost of operations by product and market</td>
<td>Expense reports</td>
<td>Shipping Dept.</td>
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<tr>
<td></td>
<td>by market</td>
<td>Shipping documents</td>
<td>Accounting Dept.</td>
</tr>
<tr>
<td></td>
<td>Fixed costs</td>
<td>Equipment logs</td>
<td>Engineering Dept.</td>
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<td></td>
<td>Variable costs</td>
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<tr>
<td><strong>Equipment</strong></td>
<td>Investment cost</td>
<td>Purchase orders</td>
<td>Purchasing Dept.</td>
</tr>
<tr>
<td></td>
<td>Maint./repair cost</td>
<td>Equipment logs</td>
<td>Engineering Dept.</td>
</tr>
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<td>Depreciation cost</td>
<td></td>
<td>Accounting Dept.</td>
</tr>
<tr>
<td><strong>Personnel</strong></td>
<td>Costs by skill, level, and operating unit</td>
<td>Expense reports</td>
<td>Department heads</td>
</tr>
<tr>
<td></td>
<td>Nonsalary costs</td>
<td>Special reports</td>
<td>Accounting Dept.</td>
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<tr>
<td></td>
<td>Cost of operations</td>
<td></td>
<td>Personnel Dept.</td>
</tr>
<tr>
<td></td>
<td>Cost of training</td>
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</tbody>
</table>

a. "Cost of operation" means the cost of performing the function.
Presenting Information to Managers

Information intended for a particular purpose must be presented in a manner that makes it comprehensible and most useful. The effectiveness of information will be enhanced if the designer adopts the following principles:

1. Present levels of detail and disaggregation that are appropriate for the particular reader.
2. Define variables, table headings, and layouts, at least for new reports and new readers, and remember that readers may not have a mathematical background or technical knowledge of the topics discussed.
3. Explain technical terms for the nonprofessional reader.
4. Use text to summarize the main highlights of tables, indicating the conclusions that may be drawn.
5. Use graphics and other diagrams to focus the reader's interest and to clarify an idea or issue.

As a management tool, reports must compare performance against plans, and against other factors such as previous years or the competition. The report should provide some type of comparative data such as "Budget" or "Previous Period," and either a numeric or narrative explanation of differences, or "analysis of variance."

Source: Adapted from Casley and Kumar, *The Collection, Analysis and Use of Monitoring and Evaluating Data.*

Distribution of Decisionmaking Authority

The debate over centralization or decentralization has been well-documented, and there are cases of successful enterprises that typify both practices. This issue should be seen in the context of a general pattern that prevails in organizations that share common goals: Responsibility for the three types of decisions to be made by the enterprise appears in the same order as one moves down the hierarchy:

- *Policy formulation decisions* are made at the senior levels of the enterprise.
Managing the Agroindustrial Enterprise

- Policy interpretation decisions are made in the middle-level management ranks of the enterprise.
- Work performance decisions are made at the lower levels of management.

Many of the decisions in an agroindustrial enterprise must be made quickly, and with a detailed knowledge of supply or market conditions. Therefore these enterprises tend to have a greater degree of decentralization in decisionmaking authority than in other types of industry. The most appropriate distribution of authority, however, will depend on the factors presented below.

Factors in Assigning Decisionmaking Authority

Clarity of Goals. If goals are clearly defined and well communicated, sound decisions can be made at lower levels of the hierarchy. A common problem in new or small enterprises is that the sponsors or owners carry the objectives around in their heads. Only they know where they want the company to go, so only they can make decisions about how to get there. The cost is congestion on the desk of the chief executive officer, delayed decisions, long communication channels, and decisions that lack the firsthand knowledge of junior managers closer to operational issues.

Clarity of Performance Standards. To the extent that performance can be quantified, or otherwise articulated so that there is no ambiguity, decisionmaking authority can be delegated to lower management levels. For example, the Distribution Department may have two goals: a delay of not more than four days to fill orders, and a minimum-cost shipping policy. Within a set budget, that department should be authorized to set its own system for processing orders and selecting the mode and company for transportation.

Interdependence of Decisions. To the extent that decisions affect other units and activities of the enterprise, they should be made at relatively higher levels. For example, deciding which area raw material will be purchased from does not affect the activities of other units of a canning plant, whereas a decision to shift from buying tomatoes to buying carrots and onions does. In this case, there are clear indicators such as date and harvest volumes on which to base the decision, but what about a change
in the size of container in which the product is packed, or the deployment of short-term surplus operating funds? There are inherent guidelines for these decisions, and they should be taken in consultation with all affected units.

**QUALITY OF INFORMATION.** Good information and communication systems facilitate decentralization. If the goals of the unit are clear and its information is adequate, accurate, and timely, it should not need to refer related decisions to higher levels of management.

**THE EXISTENCE OF STAFF UNITS.** If the company has set up specialized units that analyze particular aspects of operations (such as a Market Research Department) or oversee particular resources (such as a Finance Department), there will be a tendency to centralize decisionmaking so that it can benefit from the current input from these units. If other factors indicate the need for greater decentralization, the flow of specialized information from staff units to lower operating units must be adequate, accurate, and timely.

**THE NEED FOR HASTE.** If conditions change rapidly, or if costs increase pending decisions, they should be made near the point of action. If the business plan or other strategic planning tool has been developed carefully, the managers of responsible units will have the information they need, and alternatives from which to chose will have been anticipated. These measures will circumscribe the risk of decisions made in haste.

**GEOGRAPHIC DISPERSAL.** Other things being equal, increased geographic dispersal of operations will require greater decentralization. In addition to its relation to other factors in this list, dispersal adds to the importance of firsthand knowledge of personnel and local norms with respect to work, relationships, and business conditions when making decisions. Agroindustries that fail to take local conditions into account in their operating decisions often find themselves burdened with political and financial problems. The manager on site should be equipped and authorized to act on issues that affect the performance of the local units and their relations with the business and social community.

**PRODUCT DIVERSITY.** Diversity will normally require more centralized decisionmaking because of the choices—many of them mutually exclu-
The interdependence of products with respect to raw material, processing, and markets also requires a corporate perspective. Organizing along product lines and setting corporate goals for each department can simplify the decisions to be made within each unit and permit decentralization. This is a common practice among large food companies, for example, and those with discrete product lines such as sugar and ethanol.

**Market Diversity.** Strategic decisions about the allocation of supplies and marketing resources among markets will need to be centralized. Thereafter, operating decisions in the marketing effort will require an intimate knowledge of the market and should normally be decentralized.

**Management Capacity.** The strength of the management team of an enterprise is seldom uniform. Although the decisionmaking authority should be weighted toward the most capable individuals, to ensure its long-term effectiveness, the enterprise must introduce a management development program that will enable it to move toward a distribution of authority more appropriate for its activities and external conditions.

Where the decisionmaking authority is actually located in an enterprise will, in fact, depend primarily on the work style of the owners and senior managers, and on the cultural setting of the enterprise. It is not realistic, therefore, to suggest that the designer be given freedom to develop a decisionmaking structure that is based on the objective factors in the above list. In practice, the designer is more likely to use these factors as variables, or tools, with which to improve the decisions of the imposed structure. For example, the first factor is "clarity of goals"; the corresponding designer's technique would be "clarify goals."

**Planning Systems**

Managing the agroindustrial enterprise, or any other venture, consists of a three-phased cycle: planning, implementation, and review. So far in this chapter, the central concern has been the specific aspects of planning that are critical to the design and start-up of the enterprise. However, systems must also be introduced to ensure that planning and review become tools for effective management rather than merely reactions to crises.
Planning should not be a one-time exercise; to be effective in anticipating and responding to changing circumstances, it should take place at different points in the organization, with different degrees of formality, different frequency, and different scope. Good managers plan instinctively because they know that conditions are constantly changing. Nevertheless, to be effective, planning needs a framework, and for the agroindustrial enterprise, this framework should be the business plan.

**The Business Plan**

As noted earlier, it is extremely important to understand the objectives, or goals, of the enterprise and the fact that all questions of efficiency and effectiveness should be addressed in relation to those goals. The business plan is a comprehensive statement of the objectives of the enterprise together with a description of how the firm plans to pursue those objectives. The business plan is the basic planning document; all others contribute to it, elaborate components of it, or develop implementation details deriving from it. It is therefore essential that owners and senior managers participate in the formulation of the plan.

The business plan is also a strategic document and therefore should have a relatively long time frame. Five years is the typical framework used to address such issues as investment and marketing programs. It would be unusual for a business plan to be changed drastically every year; this would signal either a very volatile environment or inadequate care in preparing the plan in the first place. However, it is not unusual to find that parts of the plan must be changed regularly to respond either to changing external conditions or to reflect operating experience and different resource situations.

Table 6.5 presents a representative table of contents for a business plan.

The sections and subsections of the business plan form a coherent whole, but they are also modules that represent different parts of the organization, different functions, and different elements of its environment. They are subject to different change factors, and therefore may have different, independent cycles for review and rewriting. Finally, they describe actions or conditions that are the responsibility of different parts of the organization.
Table 6.5 Sample Outline of a Business Plan

<table>
<thead>
<tr>
<th>The business</th>
<th>Compose a brief statement of the nature of the business and its primary objectives.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry setting</td>
<td>Identify the markets, competitors, and suppliers that make up the industry. Focus on trends and on features of the industry that give rise to the company's marketing and operating strategy.</td>
</tr>
<tr>
<td>Marketing strategy</td>
<td>Describe the target market(s), the products to be offered, the distribution and sales network, pricing strategy, and promotion program.</td>
</tr>
<tr>
<td>Operating strategy</td>
<td>Discuss basic elements of operations such as the use of technology, location of facilities, procurement systems, staffing and management policies.</td>
</tr>
<tr>
<td>Investment program</td>
<td>Present investment plans as a logical extension of the marketing and operating strategy. Include a discussion of the timing and sequence of investment, principal reasons for choices of technology, location, and size, and, in the case of an existing enterprise, the impact on existing investments.</td>
</tr>
<tr>
<td>Resource mobilization</td>
<td>Summarize capital requirements and present a financing plan. Use a similar approach for other resources: State the need and how it will be met. For example, raw material supply arrangements, technology transfer agreements, technical assistance and management contracts, and personnel recruitment and training program.</td>
</tr>
<tr>
<td>Resource allocation</td>
<td>Present internal organization and management structure; also summarize essential information and decisionmaking systems. If this is an advocacy document, present bio-data on top managers.</td>
</tr>
<tr>
<td>Performance</td>
<td>Present key performance targets, and the analysis on which they are based. Sensitivity analysis would also be useful for reference in the later review of performance, or to strengthen the plan as an advocacy document. Indicate how performance will be monitored.</td>
</tr>
</tbody>
</table>
The planning system can be developed by examining the components of the business plan with respect to the differences cited above. Specifically, the following elements should be determined for each planning function:

- The types of information that are required for review and planning in each area of the enterprise.
- The units of the organization that are affected by changes in each aspect of the enterprise and its industry.
- The units that are best suited to conduct the review and planning.
- The resources and analytical tools required for the task.
- The frequency of review and planning in each area, or the conditions that will trigger a review.
- Consultation and managerial responsibility to review and act on the results of planning efforts.

Measurement and Control Systems

The collection and use of information for planning and implementation were discussed earlier in the chapter. Within this broad management framework, several control functions require specific attention: quality control, inventory control, cost control, and financial control.

Quality Control

As noted from different perspectives in Chapters 2, 3, and 4, the quality of a product can be described as the characteristics required or rewarded by the market. Standards, sampling methods, and analytical capacity have to be set up to ensure that these characteristics are created or preserved. Most processing enterprises would argue that separate quality control units are needed because they are economical and provide the enterprise with technical expertise. As a result, the quality control system will also need to set out the relationship between the operating unit and the control unit with respect to sampling, reporting, and corrective action.

Quality standards should be incorporated into the performance evaluation of the operating unit. Operational proxies should be developed for standards that are not self-evident. For example, set a tolerance level for faulty cans after filling and processing, offer premiums for production
above set quality mixes, or, conversely, penalize purchasing agents whose raw material purchases do not test satisfactorily upon arrival at the plant.

Enterprises that use capital equipment should establish a third type of quality control related to the efficient use of equipment, and to the prevention of accidents and damage.

If quality control is to be effective, it must go beyond the standards, sampling, and analysis identified above: (1) managers, personnel, suppliers, and agents responsible for the quality factor must understand the relationship between their actions and quality, and they must know the correct actions to ensure quality; and (2) units and individuals should only be held responsible for quality factors that are within their control.

Inventory Control

Three aspects of inventory need to be controlled: security, quality, and utility.

Inventory security can be controlled by providing secure warehouses and holding areas, properly trained personnel, and procedures that forbid the movement of inventory without proper documentation. Purchase orders, warehouse receipts, requisitions, and releases should be reconciled as part of the daily bookkeeping routine of the enterprise, and physical inventory should be taken at regular intervals.

To control inventory quality, the enterprise must have storage facilities that offer the conditions required by the stock in question and appropriate stock management practices. (See Chapter 3 for a discussion of factors in receiving and storage facility design.) A number of measures can be taken to preserve inventory quality:

1. For perishable goods, and others with stable prices, use first-in-first-out stock management to minimize the average storage period (The exception would be to move first any stocks that have flaws such as high moisture content that jeopardize their storage life).
2. Store different grades of stock separately.
3. Ensure even ventilation of stocks.
4. Move bulk stocks periodically.
5. Palletize packaged goods wherever possible to reduce the movement of individual units and improve overall ventilation.
6. Plan space use before goods are received, to facilitate orderly stocking and extraction.
7. Display date and grade on stocks wherever possible—for example, using copy of warehouse receipt.
8. Inspect stocks frequently, and isolate degraded product.

The following measures can maximize the utility of inventory:

1. In general, stock parts and supplies in quantities and locations related to their use pattern; this applies equally to distribution among storage units and to the floorplans of individual units.
2. Store fast-moving items near their point of use; slower-moving items can be stored more centrally for economy and security.
3. For parts and supplies, use the manufacturer's classification to avoid confusion between technicians and stock personnel.
4. Review automatic repurchase orders annually.
5. Dispose of related stocks of supplies and parts when equipment is abandoned or sold. Otherwise, these artificially inflate inventory values and lead to large exceptional expenses when they are eventually disposed of.

Cost Control

To achieve effective cost control, budget and accounting systems should be based on cost or profit centers. Controls should be established for both procurement and operations. Effective control normally depends on the following measures:

1. Develop standard costs for enterprise activities.
2. Distinguish between the fixed and variable components of activity costs.
3. Prepare and monitor budgets according to these standards.
4. Require responsible managers to explain why actual costs vary from set standards (Expect variation, and use good explanations to improve on future standards).
5. Require all units to prepare procurement plans to demonstrate adequate anticipation of needs, the extent of quantity or timing discounts, absence of stock-outs, best freight rates, and other cost factors.
6. Design the procurement system to prevent unauthorized purchases; require more than one signature on purchase orders.

**Financial Control**

Financial control consists of ensuring that the enterprise is solvent and maximizing the earnings available to the shareholders. Cost control is a part of financial control in the sense that it influences the financial performance of the enterprise. However, the term “financial control” is usually applied to the mobilization and management of money and financial assets. More specifically, financial control consists of several activities:

- Ensuring that adequate capital is mobilized at the lowest real cost, usually through a combination of equity and various debt instruments, timely placement of these instruments, and effective use of interest rate differentials among instruments of different maturity.
- Ensuring that temporary capital surpluses are productively employed in short-term instruments.
- Enforcing cash management and banking procedures that minimize the risk of theft and misuse.
- Making effective use of credit terms for accounts payable and minimizing the age of accounts receivable to create additional liquidity for operations.
- Ensuring that retained earnings and reserve funds are fully employed in instruments and on terms that are consistent with the future investment program and reserve needs of the enterprise.
- Establishing a dividend policy that maintains shareholder interest, but retains adequate earnings for financial and operational investment.

Chapter 5 presents financial planning and analytical techniques for agroindustries and discusses the financial implications of many of the characteristics of this type of enterprise. Control should be based on the analytical techniques developed in Chapter 5 and on good budgeting and accounting systems. The basic tools of financial control are summarized below.

**Capital Budgeting.** The projection of capital needs for investment and debt retirement is the basic planning instrument for the solicitation of equity and long-term debt financing. It guides the timing and level of
fund-raising efforts; it enables the enterprise to anticipate needs and to find least-cost sources and combinations of capital; it gives lead time in building capital structure so that the enterprise can satisfy the debt-equity ratio and other requirements of prospective financiers.

**Operations Budgeting.** Short- and medium-term capital needs will become clear from financial projections, as will the inflow of funds. Cash flow projections will signal the magnitude and timing of net inflows and outflows, which the Finance Department can use to anticipate the need to employ temporary surpluses or locate funding from nonoperational sources.

**Ratio Analysis.** This technique is used not only in budgeting, but also in monitoring and controlling actual operations. Accurate, timely financial data are essential for effective control, and liquidity and creditworthiness ratios are the most important control factors, particularly current and quick ratios, collection period, receivables aging, inventory turnover, and debt-service ratio.

**Internal Procedures.** Clearly defined procedures are required to ensure that liquidity is constantly employed, that cash and financial assets are not subject to theft or diversion, and that deficits are not permitted to develop to the point where penalties are incurred. Penalties include late charges and forgone discounts, but they also include damage to credit rating and reduced credit facilities on subsequent transactions.

**The Transfer of Technology**

Technology may be transferred through many means. In its simplest form, this transfer occurs whenever a firm employs a worker with skills that are not already present in the firm or buys a new piece of equipment that is effectively integrated into its operations. At the opposite extreme, complex contractual arrangements are often required to gain access to proprietary technology involving the transfer of equipment, specialized personnel, materials, and legal rights.

How to choose a technology for the enterprise was discussed in Chapter 3, along with the general issues that bear on skill level and sophistication of equipment. However, the acquisition of proprietary technology poses additional challenges for the enterprise. Once the analyst and spon-
sors have satisfied themselves of the appropriateness of a particular technology for their circumstances and for their business strategy, they must address the terms and conditions under which they will gain access to that technology.

The Technology Transfer Agreement

The effectiveness with which technology is actually transferred from the competence of the proprietor into the competence of the buyer depends on the terms and conditions governing the transfer. In most cases, the dissatisfaction associated with this process can be traced to vague or incomplete agreement on the rights and responsibilities of both parties at the time of negotiations.

The principal elements of an agreement for the transfer of technology are discussed in the following paragraphs. Although it may be appropriate to put some of these elements in side letters, technical appendixes or other forms rather than in the body of the contract, they should all be explicitly agreed upon in writing.

**DESCRIPTION OF THE TECHNOLOGY.** The nature of the technology to be supplied should be described in detail. A “black box” description that simply describes the end product is insufficient either as a basis for fixing responsibilities under the agreement or for assessing the value of the technology to the buyer. The processes and equipment that are essential to the technology should be described, and the basis for patents stated. Operating parameters such as minimum infrastructure needs and input standards should be stated.

**List of Goods and Services to Be Supplied.** The transfer will take place in the form of some combination of equipment, personnel, written materials, computer software, spares, inputs, intermediate goods, and legal rights. The elements of a particular transfer should be clearly stated so that performance under the contract can be judged, but also so that the adequacy of the package to effect transfer can be assessed.

**ACCESS TO PATENTS.** In most cases of technology that is embodied in equipment or materials, the buyer will not need to obtain access to patents. However, where the patent relates to processes, the conduct of which requires specialized human skills, the technical details contained
in the patent may be a necessary part of the transfer. Access to patents gives the buyer the opportunity to use that technological advancement as a basis for devising further developments or for designing replacement technology. Therefore, if the seller is willing to share patents or detailed engineering or chemistry information, there will be a price on this aspect of the agreement, and there will be either explicit restrictions on the use of this material or a statement as to how it is to be used.

**Restrictions.** A technology often has a number of applications. Each application will have a number of markets. The seller of a technology will seldom grant unrestricted use to the buyer, and so it is essential to clearly specify the restrictions. There may be phases to such restrictions, whereby they would be progressively removed upon satisfactory completion of conditions. In any event, the buyer should be cautious of restrictions that limit application indefinitely to the scope of the present business plan. The whole idea of buying technology is to enable the firm to grow and expand; it should have continued access to this asset.

The seller will also be concerned that the circumstances under which the technology is used meet the standards for which the technology is designed. If they don't, output quality and the reputation of the technology may be jeopardized. On the other hand, the buyer will wish to limit its dependence on the seller for ancillary items such as spares, packaging materials, and raw materials if these can be obtained elsewhere. This is an area for negotiation in which the buyer must be satisfied of the need for any restrictions, and the reasonableness of any additional costs such as supplies that result from the restrictions.

**Confidentiality.** The buyer will normally have to provide internal security for the technology, to disclose it only under the terms and conditions expressly set out in the agreement, and to use its best efforts to prevent the technology from falling into the hands of third parties.

**Labeling.** The agreement should cover two aspects of labeling: identifying the technology and using labeling as a marketing device. In identifying the technology, many labels on the output product include a statement such as “Manufactured by (the buyer) under license from (the seller).” The seller may also request that a statement be included concerning the patents, either their numbers or their status and their geographic coverage.
Labeling for marketing purposes, including the use of recognized brand names, has an explicit value in terms of expected sales performance. The buyer should therefore expect to pay an additional charge for this privilege, over and above that for the use of the technology. To use a brand, the seller will insist on quality standards, not only for the product, but for the business operations related to the sales and distribution of the product; pricing will also be a concern. In return, the buyer should ensure that support such as brand advertising and promotional materials are supplied, as well as packaging and labels at agreed prices.

TECHNICAL ASSISTANCE. Although resident and short-term technical support will have been identified in the list of goods and services to be provided, as noted above, this aspect of the agreement must provide specific details:

- Numbers, qualifications, and duration of assignment with the buyer for members of the technical support team.
- Associated needs such as transportation and accommodation. Who arranges and who pays?
- Headquarters support to be provided by the seller.
- Training of the buyer's personnel at the seller's installations. Who arranges and who pays?
- Authority to determine when and what assistance is needed during the period of the agreement.
- Financial arrangements for assistance over and above that specified in the agreement.
- Training obligations of personnel providing technical assistance.

QUALITY CONTROL. The seller will normally insist that adequate control be exercised over the factors that influence the performance of the technology and over the handling and sale of goods produced using the technology. This is the basis of the seller's warranty on performance and the means of protecting the reputation of the technology in the marketplace. The standards to be enforced, the means of testing and control, and the training or technical support for quality control personnel should be stated in the agreement.

WARRANTY. The seller must warrant that the technology will perform to specific standards, under the conditions set out in the agreement. This
performance must be stated in terms that can be monitored during operations, and in terms that have an economic value that the buyer can use to assess the value of the technology. Remedies must also be spelled out.

**TERMS OF PAYMENT.** It is unusual for process technology to be transferred through outright sale. Sellers generally prefer to negotiate rights to the use of their technology, and there is in fact an advantage to buyers in this arrangement, in terms of continuous support, provided that support is clearly stipulated and fairly priced. There may also be financial advantages to arrangements other than outright sale, including reduced debt burden on capital structure and cash outflow being related to use and therefore to cash inflow.

A transfer agreement may include some or all of the following compensation provisions:

- The purchase or lease of equipment used in the technology.
- The purchase of consumables, raw materials, packaging materials, spare parts.
- The payment of royalties, license fees, or other charge expressly intended to compensate the seller for granting access to intellectual property. These will normally consist of a fixed portion and a portion related to level of use, usually measured on the basis of time or volume of output. These fees may include the basic level of technical support services and a set package of promotional assistance in marketing the product of the technology.
- Revenue or profit-sharing provisions.
- Payment for technical support, training, and related costs.
- Separate payment for exclusive marketing rights, the rights to future improvements in the technology, or other ancillary privileges.

It is important to clarify when payments are due, the currencies and means of payment, and financial or other remedies if either party fails to honor its obligations under the agreement. Most compensation packages will require some form of information disclosure and provide for independent verification of information on which compensation is based.

**DURATION.** It is in the buyer's interest to ensure that access to the technology will continue, at least long enough to permit the full recovery of the related investment, with an adequate return. If the technology per-
tains to a large scale process, for example, buildings and related infra-
structure will need to be provided, and these will need to be factored into
the judgment of appropriate duration of the agreement.

In the case of technical assistance agreements involving only person-
nel, the contract may be of short duration initially, with extensions or
longer follow-up agreements if both parties are pleased with the results of
the earlier agreement. Agreements involving the transfer of capital goods
and intellectual property cannot use duration in this manner to ensure
continued satisfaction by both parties. The related investment costs are
usually too high, and longer-term market development efforts are usually
required. For these agreements, performance warranties and other obliga-
tions must be used to define mutual satisfaction ahead of time. Financial
and legal remedies can then be specified to limit, suspend, or terminate
the agreement in the event of failure on the part of one of the parties to
perform satisfactorily.

**ACCESS TO MODIFICATIONS AND FUTURE DEVELOPMENTS.** In most cases
it will not be possible to reach agreement on the terms of access to future
technological developments because their nature and value are unknown.
However, to the extent that such developments improve upon the pur-
chased technology, or diminish its market value, the buyer should insist
on at least the right of first refusal. The price of that right should be nego-
tiated from the point of view that it merely preserves or enhances the ben-
efits expected from the initial agreement. If future developments improve
upon the purchased technology, the seller may insist that the buyer adopt
such modifications as a means of ensuring the consistent improvement of
quality among all users of the technology.

Developments by the seller that are not directly related to the technol-
ogy covered by the present agreement may be of interest to the buyer as a
means of building on a brand name, a marketing channel, or a product
line. It is therefore useful to insist on the right of first refusal on such
developments, to the extent that they fall within the general competence
of the buyer. Such a right would bear the same restrictions, such as mar-
ket area, as those of the initial agreement.

**Managing under Contract**

Under most circumstances, the owners or sponsors of an enterprise will
employ individual managers directly as part of their own personnel com-
plement. Under certain conditions, it may be appropriate to contract the management of an enterprise to another company:

- The enterprise may differ significantly from others that make up the majority of the owners' business interests and may be outside their area of expertise.
- The enterprise may be based on a sophisticated or uncommon technology, for which the cost of developing in-house management expertise is too high, at least in the short term. In such cases, management may become part of the technology transfer agreement.
- The condition of the enterprise may have deteriorated to the point that it demands an inordinate share of the owners' management efforts or cannot be rehabilitated without special management expertise. Creditors may participate in the decision to contract management under these circumstances.

In the late 1980s, many public sector agroindustrial enterprises that had experienced poor operating results over a number of years were placed under management contract as a means of introducing management skills that could not be provided from within the public service. In some cases the management contract served as an interim measure to prepare the enterprise for sale; in others it has proven to be a sound long-term division of functions between ownership and management. During the same period, commercial banks and development finance companies acquired control of many failing private agroindustries that had experienced trade and debt service problems as a result of bad management or adverse economic conditions. Some of these have continued to operate under management contracts imposed by the creditors.

There is a high financial and emotional cost in waiting for a company to get into trouble before obtaining external assistance. Owners who have been through the cycle will attest that it is difficult to know when to seek help after problems begin; if they had the information and resources to make that decision, perhaps they would not have been in trouble in the first place. The cycle can be avoided if, at the planning and development stages of an enterprise, careful thought is given to management needs and a realistic judgment made as to the feasibility of the enterprise being able to manage itself internally. Occasionally it is external investors who force the sponsors to address this difficult issue, but in any event, the cost will be less in the long term if an accurate assessment of management needs is made at an early stage.
The basic feature of contract management is that the contractee is held responsible for the outcome of the activities managed rather than for individual decisions and actions. Therefore the conditions under which this responsibility is delegated must be clearly set out; the scope of responsibility must be agreed and authority delegated commensurate with the responsibility.

Prerequisite Steps for a Management Contract

Most of the work to be done before a management contract can be effectively negotiated consists of taking stock: What do the owners wish the enterprise to accomplish, and what is the condition of the resources available to the enterprise? Although the prospective management company will wish to independently assess the prospects and condition of the enterprise, the owners must form their own assessment as a means of judging the adequacy and fairness of the conditions emerging from the negotiations.

Clarify Business Activities and Goals. This encompasses the principal elements of the business plan outlined earlier in this chapter: description of the business, marketing strategy, and operating strategy. These will be the basis on which the scope of the contract, authority, and performance targets are developed.

Evaluate facilities. Owners should assess not only the physical condition of the chattels and fixed assets of the enterprise, but their productive capacity in relation to performance targets. An estimate of necessary improvements or replacement cost prior to, or during, the prospective contract should also be made.

Appraise stocks and inventories. Both parties will need to know the materials available at the outset—their quantity and condition. A physical inventory, combined with price checks, will probably be required, as stock lists at book value are usually inadequate to assess the actual quantities, value, condition, and degree of obsolescence of the materials on hand.

Assess the financial condition of the enterprise, and the adequacy of the accounting system. To evaluate performance under the
contract, it will be necessary to know the starting financial condition of
the enterprise. The system of records and reports must be current and
adequate. Troubled enterprises frequently have poor accounting system
and are one or more periods behind in their records. The management
contract may call for improvements in this system; in such a case, other
elements of the contract such as performance targets may have to be held
in abeyance, or be made subject to renegotiation after accounting work is
complete.

Elements of the Management Contract

STATEMENT OF PURPOSE AND SCOPE OF CONTRACT. This statement will
define the intent of the contract. Although much more detail will appear
in subsequent sections, it will set the spirit of the agreement, which can be
used to govern the interpretation of other clauses and to communicate
with third parties concerning the nature of the relationship between own-
ers and managers.

ACTIVITIES TO BE MANAGED. In most cases, the activities to be managed
will encompass all the operational and support activities of the enter-
prise, subject to the restrictions on authority set out in the agreement and
subject to compliance with other contracts binding on the enterprise at
the time of the agreement.

PERSONNEL AND OTHER INPUTS TO BE PROVIDED BY MANAGERS.
Although the contract is based principally on output performance, it
should identify key personnel and other basic inputs and stipulate how
the owners' views on future additions or replacements will be sought. If
inputs are to include proprietary goods or know-how, the agreement
should state the rights of the owners of the enterprise to such inputs, and,
if the managers are not the owners of the goods or know-how, the agree-
ment should state the basis on which they have the right to furnish them.

FINANCIAL RESOURCES AVAILABLE FOR OPERATIONS. Ideally, the con-
tact should identify lines of credit, other short-term facilities, and addi-
tional equity and term credit that are available to the managers for the
working capital and investment needs of the enterprise. If this is not pos-
sible, there should be a statement outlining the responsibilities of the
owners with respect to securing external financing, and the fact that performance clauses in the contract are contingent upon the availability of adequate capital.

AUTHORITY AND REPORTING RELATIONSHIPS. Authority delegated to the managers should be specifically described in at least the following areas:

1. The document on which authority is based should be identified—this will usually be an annual budget and work plan approved by the owners.

2. Authority to contract with third parties for the purchase of materials and supplies, the purchase of capital goods, the sale of outputs, the purchase and sale of services (including labor negotiations), and authority to incur debt for general operating purposes and to invest surplus funds. It is unlikely that owners will delegate unlimited power in these respects, but the limits should be stated. His authority must be consistent with prevailing commercial law.

3. Authority to employ, reassign, terminate, and alter the compensation of personnel. Again, the limits of this authority should be stated. It is in the interests of the contracting parties that any major anomalies such as excessive staff levels or areas of inadequate qualification be addressed as a prerequisite to signature of the contract.

4. Arrangements for routine reporting to owners, frequency of meetings with the board representing the owners, process for resolution of disputed decisions, frequency of review of the work program and budget.

PERFORMANCE TARGETS. Performance targets should be readily measurable, and they should be related to the goals of the enterprise as stated in the contract. Two aspects should be identified: basic targets, and increments above or below those levels for which premiums or penalties will apply. Basic performance targets should be specifically stated in the contract. They may be long-term targets, such as "achieving an average growth in production of 15 percent per year over the next five years." They may be in the form of ratios that are independent of the exact level of operations such as "earn net income of not less that 20 percent of sales before tax" or "operate the (facility) at not less that 75 percent of capacity
for a period of not less than 100 days per year." Incremental targets can be
stated as a formula.

MONITORING AND REPORTING ARRANGEMENTS. This element may be
adequately covered under authority and reporting relationships. How-
ever, the agreement should specify the scope and frequency of the reports
to be submitted by managers to the owners, the manner in which ques-
tions and concerns arising from these reports are to be handled, and con-
versely, the obligations of owners to report developments of concern to
the enterprise to the managers. Provisions for independent audit should
be agreed.

COMPENSATION. To realize the greatest benefits from a management
contract, the owners should insist on a compensation package that is
based at least in part on performance. However, managers will recognize
that the performance of the enterprise—particularly an agroindustrial
concern—does not depend entirely on the quality of their efforts, so they
will usually insist on the payment of most costs irrespective of perfor-
ance. As a result, the typical management contract will have a three-
part compensation formula: personnel costs, other reimbursable costs,
and performance-related payments.

Personnel costs. These will include salary as well as related costs such
as travel, accommodation, and nonsalary benefits. This is to be a reim-
bursed item, so it should be defined in detail in the agreement. To the
extent that the new managers substitute for personnel of the enterprise,
this is a replacement cost, but in most cases the level of effort and the level
of skills will result in a significant net increase in the cost of management
personnel for the enterprise. The justification will lie in improved finan-
cial performance.

Other reimbursable costs. These costs will normally be a relatively small
category including facilitating expenses such as local transportation,
communications, contract administration, and headquarters support of
the management team. However, related activities may be performed by
other employees of the management company (such as freight forward-
ing, marketing, or procurement), which are to be paid for as reimbursable
costs.

Performance-related payments. These payments will be based on the
performance factors set out in the contract. In the three-part compensa-
tion formula, they represent the profit element for the managers. The per-
formance element should begin only above a base level of performance, and it may be appropriate to have one or more break-points in the rates of payment. For example, as an efficiency incentive for managers of a sugar mill, the contract could stipulate that at least 80 percent of sucrose in the cane must end up as sugar in the bag. Yields between 81 percent and 85 percent will earn a management premium of 1 percent of the value of sales ex-warehouse, while yields above 85 percent will entitle the managers to a premium of 2 percent of sales.

The compensation clauses should also state the timing and method of payment and the currencies in which various payments are to be made, and, if local law requires any withholding of a portion of payments for tax or other reasons, treatment of such amounts should also be stipulated.

**DURATION.** There are four factors to consider in determining the appropriate duration of a management contract.

*The level of effort and extent of preparatory activities.* Management firms will not be interested in a contract that does not provide them adequate time to recover the up-front costs incurred in negotiating and starting up the work.

*Condition of the enterprise.* If it is in poor condition and the purpose of the contract is to effect significant change, the duration of the contract will need to be longer than if the contract is a caretaker arrangement for an enterprise that functions well.

*The compensation arrangements.* If the payment formula is based on performance, and a certain period of time is needed to improve the performance of the enterprise, the managers will insist on a contract of longer duration so that they can recover forgone profits from early years in the years after the results of their efforts begin to show on the books of the enterprise.

*Other aspects of the overall corporate strategy.* If the contract is part of an overall corporate strategy, other aspects of that strategy will dictate the period available for contract management. For example, the owners may have set a timetable for the development of its own managers, or for the sale of the enterprise; a distressed enterprise may be given a set period of time by its creditors or the courts in which to rehabilitate the operation, or face sale or liquidation.

**Remedies.** Both parties to the management agreement need to recognize that, even with the best of intentions and ability on both sides, things
will not always go according to plan. The contract should set out the circum-
cumstances under which each party is entitled to seek either a change in
the conduct of the other party or the amendment, suspension, or cancella-
tion of the contract. These clauses are important in themselves, but they
will also ensure that the owners and managers have thought through the
types of contingencies that may arise during the course of the contract.
Socioeconomic Evaluation of Agroindustries

The preceding chapters have presented an applied approach to agroindustrial investment analysis, with the emphasis on commercial, technical, and financial evaluation. The analyst must recognize, however, that social and economic factors can also have a considerable impact on how well investment proposals are received by public officials and the community, and, ultimately, on the financial success of the venture.

The economic and social aspects of investment have been the subject of comprehensive investigation, and many publications on the subject are available for the student of economics or development planning. J. Price Gittinger's *Economic Analysis of Agricultural Projects* has been widely used in development projects since the first edition was published in 1972.

Value of Socioeconomic Analysis for the Private Enterprise

Financial analysis focuses on the impact of an investment on the financial condition of the enterprise in question. Financial transactions represent the most immediate and the most direct consequences of an investment decision, but they are by no means the only consequences. The economy in which the investment is to take place will also experience costs and benefits that will not appear directly in the accounts of the enterprise. The principal objective of economic analysis is to capture these costs and ben-

efits and thereby to obtain a clearer understanding of the investment's overall impact on the economy in which it will operate.

The results of socioeconomic analysis can be useful to commercially oriented investment in a number of ways. They can

1. Anticipate the attitude of planning authorities and other government departments toward the proposed investment and therefore help to plan the strategy to secure investment approval.

2. Signal to investors the need to reassess the balance of capital and labor, or other production parameters in the proposed investment.

3. Highlight the potential susceptibility of the operation to the loss of existing incentives and protection.

4. Identify policy issues in related sectors, such as the control of prices in agriculture, which could impinge on the performance of the enterprise.

5. Identify interests within a community that might object to the proposed investment and why, and provide possible solutions to the dispute.

6. Persuade government to share in infrastructure costs (roads, ports, power supply, etc.).

7. Provide a basis for seeking outside financing in the operation from development assistance sources.

8. Strengthen the case for incentives or protection for the new enterprise, to be negotiated with public officials.

9. Identify economic distortions or inefficiencies that may require government intervention in the future, such as a devaluation, with consequences for the proposed investment.

The first part of this chapter examines the role of agroindustrial enterprises in the economic development process, and consequently the importance attached to this type of activity in the investment policies of developing countries. It also highlights the development characteristics usually attributed to agroindustries and the circumstances under which they can actually be expected to appear. The second part is concerned with the elements of socioeconomic analysis and the quantitative measures by which market prices are converted to economic prices for purposes of this analysis.
Agroindustries and Economic Development

Any investment will inevitably have repercussions within the economy it serves that are wider than simply returning (or failing to return) dividends to shareholders. These repercussions are particularly strong in the case of an agroindustry. A postharvest enterprise can influence the volume and disposition of agricultural production; it can affect the degree of food self-sufficiency, induce changes in infrastructure, enhance employment, and contribute to foreign exchange earnings.

Investors who understand agroindustrial characteristics and the development objectives at issue are better equipped to take economic objectives into account in their design decisions. Development authorities who also recognize these features will formulate more constructive investment policies, and base their plans on more realistic expectations of the economic benefits of the proposed investment.

The characteristics commonly attributed to agroindustries do not apply to all activities, nor to all the circumstances in which any one postharvest activity can take place. Furthermore, the development objectives pursued through the promotion of agroindustry are often conflicting, so that an investment may contribute to the fulfillment of one objective only at the expense of another. The objectives typically pursued through agroindustrial investment promotion are discussed below, along with the conditions under which these objectives are most likely to be advanced.

Agroindustry and Development Objectives

Most development objectives that are pursued through agroindustry investment are interrelated and at times may complement one another. For example, activities with limited economies of scale normally build on established craft traditions and permit broad ownership in the sector. At other times, development objectives may conflict. Activities with limited economies of scale may be chosen in order to promote small and medium industry and the national ownership of capital, but that choice may limit the technology that can be adopted and the extent of value added.

Greater Food Self-Sufficiency. Economies at the earliest stages of development, such as those found in peasant communities, are normally self-sufficient in food. However, when urbanization takes place or incomes rise, the variety, quality, and—initially—the quantity of food
demanded increases. At the same time, urbanization and specialization of employment reduce the share of the population engaged in food production. Unless producers can respond rapidly by increasing production in the face of the resulting decline in the availability of local land areas and rural work force, food will become scarce and will have to be imported.

It is not usually sound economic policy for a country to pursue self-sufficiency in the entire range of foods demanded by its population, but a dependable supply of staple foods is often a political and strategic imperative. An agroindustry that preserves perishable foodstuffs makes it possible for them to be stored and distributed to urban areas as needed. Agroindustries can also provide domestic alternatives that reduce the demand for imported processed foods upon which consumers place a high value, such as soft drinks and breakfast cereals.

INCREASED AGRICULTURAL PRODUCTION. In traditional agriculture, production decisions are based on the subsistence needs of the farm family and on market expectations. To decide how much additional effort to expend on land and farm inputs, producers try to judge the quantity of output that can be sold at a satisfactory price. Efficient postharvest systems that can extend the shelf life of farm products, increase their geographic distribution, or convert them into other products through processing increase the demand for commodities beyond that of the local population. Provided that the producers share in the increased value of the total crop through higher farm income, the existence of postharvest enterprises is an incentive to increase production.

REDUCED FOOD LOSSES. The basic function of most food processing and storage operations is to preserve a particular product. Efficient postharvest systems increase the supply of food available from any given level of farm production and maintain its quality. As a result, average consumer prices for food can be lowered while returns to producers can be increased. One of the most critical issues surrounding food policy is how producers, intermediaries, and consumers share this additional value.

IMPROVED NUTRITION. By ensuring that a greater share of farm production is available for consumption, agroindustries can reduce the average cost of food and make more of it available to lower-income consumers. Seasonal price fluctuations will normally be reduced and the range of
foods needed for a more balanced diet will be available for a larger part of the year.

Processing reduces toxicity in some foods and enhances the flavor or nutritional value of others. Food fortification is a low-cost supplementary function that may be introduced in staples such as flour, or in specialty foods for nutritionally vulnerable groups such as children.

Employment Generation. Most agroindustries generate employment at a lower capital cost than other types of industry. Many enterprises evolve from traditional crafts and retain a relatively low level of technology so that the requisite skills are available in a rural society, or can be readily acquired. Not only do developing countries have a higher proportion of agroindustry than industrialized countries in their manufacturing value added, but the labor share of that value added is also higher.

Agroindustry also has considerable influence on the type and location of employment generated. Where raw materials are produced in a geographically dispersed pattern, jobs can be created for the rural population close to where they live, thereby reducing the pressure for urban migration and increasing purchasing power in rural areas. This pushes up the rural demand for goods and services, a share of which will be locally produced.

Development of Skills and Technology. Unlike other branches of industry, such as petrochemicals, which are the result of modern technology, most agroindustries originated in traditional activities. Agroindustrial operations that use low and intermediate technologies provide an ideal introduction to modern technological concepts as well as manufacturing and organizational skills. When the time comes for an enterprise to advance to a higher level of technology and more complex production processes, workers, entrepreneurs, and managers will have acquired the basic mechanical skills they need to move forward, a knowledge of the variables to be managed in any industrial process, and an understanding of the cultural aspects of an industrial work environment.

Planners interested in developing skills and technology through agroindustries need to consider the rate at which technology is changing in any particular process before moving ahead in this direction. Rapid change, or the penetration of a local market by a sophisticated competitor, may render an investment obsolete before it is fully depreciated.
DEVELOPMENT OF DESIGN AND MANAGEMENT CAPABILITY. Any industrial activity must be adapted to the circumstances in which it is to take place. The physical and cultural conditions of the surrounding environment must be reflected in the design and management of an enterprise if it is to succeed. For example, agronomic and climatic factors influence the character of raw materials; infrastructure places constraints on location, capacity, and support services; and culture governs attitudes toward ownership and management patterns as well as working conditions. These local circumstances stimulate the development of indigenous design and management capabilities that have broader application in the industrial sector and elsewhere in the economy.

NATIONAL OWNERSHIP OF CAPITAL. Before a community can create domestically owned fixed capital, it must have the capacity to create savings, the institutional capacity to assemble and distribute those savings, entrepreneurs, viable investment opportunities, and a favorable investment climate.

In the early stages of development, fixed assets are created on a modest scale through personal savings and borrowing in the informal sector. Most indigenous entrepreneurial activity is focused on commerce, and any significant industrial investment tends to be carried out by the public sector or a foreign entity. Financial markets are not well developed, infrastructure is weak, and supporting services such as technical assistance are inadequate.

Here, again, the notion of agroindustries as a stepping stone becomes important. The fact that some processes can be viable on a small scale places them within the financial reach of domestic entrepreneurs to a greater extent than many other forms of capital investment. Their craft origins and moderate levels of technology make them a more familiar entity to entrepreneurs, who will therefore be less reluctant to invest in them and perceive less financial risk.

GENERATION OF FOREIGN EXCHANGE. Raw material exports have historically been the dominant source of foreign exchange for most developing countries. In the past 30 years, markets for the majority of these exports have been increasingly unstable and the real price of most agricultural commodities has been declining.

Domestic processing of raw materials may be a means of earning more foreign exchange from the same raw material base by adding value to
each unit of export and stabilizing those earnings by widening the range of products that can be offered to international markets. By diversifying its products, the exporting country no longer has to rely on a small number of importers and can also gain access to other markets that do not have their own processing capacity.

**IMPORT SUBSTITUTION.** Import substitution, which is closely related to self-sufficiency and foreign exchange objectives, is another important policy consideration in many developing countries. Since substitution usually involves relatively sophisticated products with an advanced degree of processing, there are economies of scale in their manufacture, and certain requirements with respect to labor skills, capital, and market size to take into account.

As a rule, the higher the degree of processing, the greater the cost of inputs other than for the basic raw material. The scope for foreign exchange savings through import substitution is therefore constrained not only by technological capability in the import substituting country, but also by the total costs of the inputs that may still have to be imported.

Substitution may take place gradually through a program of progressively rising domestic content, beginning with local assembly, the blending or packaging of foreign components, and moving toward more complete domestic input.

**INCREASED PUBLIC SECTOR REVENUES.** Adding value to raw materials in the industrial sector increases the economic base from which public revenues are derived. Furthermore, the wages, interest, rent, and profits that make up this added value are normally earned by different segments of society, with the result that the burden of contributing to public sector financing is spread more widely through the population.

The value added by processing is of particular interest to fiscal authorities if the product can be exported. In many countries foreign exchange transactions must be handled through a public sector agency such as a central bank, and the exporter receives payment in local currency. In such cases, it is not simply the additional tax base that leads authorities to promote processing, it is the fact that processing may diversify markets or otherwise stabilize or expand foreign exchange earnings that will accrue to the public sector.

Such a system may have a deterrent effect on investment, particularly if it is associated with inappropriate exchange rates, export taxes, licens-
ing, or restricted access to foreign exchange for inputs. Public sector monopolies in domestic trade designed to capture the added value for the public sector, such as marketing boards, can have a similar deterrent effect on local markets for both producers and processors, particularly if they suppress producer prices and the operating margins of intermediaries or delay payment to producers.

**GEOGRAPHIC DISPERSAL OF ECONOMIC ACTIVITY.** The primary raw materials used by agroindustries are normally produced in a wider geographic area than are the raw materials for other industries. In addition, as already mentioned, the infrastructure and skills required by agroindustries may be less complex and there may be limited economies of scale to be concerned with, so production can be directed at smaller regional markets.

Normally, agroindustries are not highly dependent on imported materials, and their processes usually reduce weight or increase value per unit of weight with the result that the share of freight in total costs is also lower. These industries can be located in areas away from ports, in contrast to many other industries, which must be near marine transport and therefore contribute to congestion, other economic inefficiencies, and regional imbalances in the rate and level of development.

**Economic Characteristics Commonly Attributed to Agroindustry**

The stereotype of an agroindustry is a development economist's dream: it makes extensive use of labor and requires limited quantities of capital to add value to local raw materials, close to where they are produced, while serving as the training ground for new entrepreneurs and earning foreign exchange for the public treasury. In practice, agroindustrial activities are far from homogeneous with respect to their use of inputs or in their contribution to any other development objectives. Furthermore, as the sector evolves with a growing economy, it often must give up many of the features that in the early stages made it appealing. In these respects, they are like the raw material on which they depend: heterogeneous and cyclical. Entrepreneurs and development planners alike must escape the generalities of agribusiness if they are to facilitate the flow of benefits that the right agroindustry in the right setting can generate for its economy.
ADDITION OF VALUE TO DOMESTIC RAW MATERIALS. Most agroindustries preserve or transform domestic raw materials. For an efficient agroindustry working under normal market conditions, this process results in increased value, which can promote and stabilize the production of raw material and generate returns to the economy in the form of wages, interest, rent, and profits. These are the conditions most economic planners try to meet when they advocate the development of agroindustries.

Value may increase for a variety of reasons. For example, the product may be more useful in a processed form (e.g., tanned leather is more valuable than green leather); the processed product may be in strong demand during seasons when the original fresh commodity is unavailable; or an effective distribution system may increase value by supplying the product to markets of relative scarcity (e.g., seafood to inland communities).

However, there are many circumstances under which higher prices do not represent value added. Packaging, for example, particularly if it consists of imported materials, may contribute more than 50 percent of the cost of a finished agroindustrial product and may account for almost all of any claimed increase in value. Or, agroindustrial enterprises acting as monopsonies (i.e., the only buyer for a commodity) may pay below real market prices and hence add value only through their position of control, and the apparent profit from the processing operation will, in fact, be extracted from producers.

Note, too, that value added from an agroindustrial process may not be constant. Changes in seasonality (i.e., raw material costs), product mix (less profitable products may have to be produced during some periods to maintain plant operations), or relative world prices may all significantly influence value added.

GEOGRAPHICALLY DISPERSED RAW MATERIAL BASE. In general, processed products weigh less and have more value than the raw materials, and therefore they will cost less to transport. Consequently, plants are often located near the source of raw materials. In view of the broad dispersal of agricultural production, it is often argued that agroindustrial investments provide employment beyond the large population centers and serve as growth centers for ancillary and spin-off activities, thus fostering more geographically uniform development.

Although these are advantages in many cases, the investor should be aware that at times they may mask hidden costs. The savings from locating a plant near its raw material may in some instances be offset by
higher transport costs when the processed goods require particular care because they are fragile or hygiene is a prime concern. In other cases, bulk transport may be possible for the raw materials (e.g., milk or grain), whereas the processed product has to be transported in a packaged form at a higher cost. Furthermore, if common carriers or multipurpose vehicles are available for raw materials, the costs of this form of transport may be far less than they would be using the specialized equipment sometimes required for processed goods.

The best design and location of postharvest facilities also depend on the intensity of raw material production, a factor closely related to dispersal. Rain-fed grain production and pastoral husbandry require more corresponding space per unit of output than the irrigated and feedlot operations, and hence a much larger supply area to support a processing operation. Extensively grown raw materials may be better processed in several smaller plants. In any case, transport constraints require careful attention.

The infrastructure needed to support processing operations (such as electricity or roads) is usually expensive to build and needs to be designed in a corridor or pocket pattern if it is to be efficient. Widely scattered enterprises cannot function without an efficient public transport and power network, unless, of course, they incur the added cost of installing their own infrastructure.

The geographic dispersion of the outlying population is another important factor to consider in agroindustrial projects. If an enterprise has to draw its personnel from a distance, it may need to provide transport, social amenities, and housing or pay premium wages, all of which will be a permanent additional cost of production. Training and turnover costs will also be higher.

**LIMITED INDUSTRIAL LINKAGES.** Agroindustries are an attractive means of fostering industrial development because, on the whole, they are not as dependent on other industrial activities as are enterprises that produce nonagricultural products. For example, a flour mill requires an agricultural raw material and a transport system to deliver the finished product to a consumer marketing chain, whereas a machine tool enterprise requires the output of steel mills and foundries to produce goods primarily for industrial customers. Even agroindustries such as rubber- and fiber-processing operations, which produce mainly for industrial markets, do not require as complex a system of horizontal links for consum-
ables and support services as is the case with other industries. What most agroindustries do require, however, is a dependable supply of packaging materials. Whether cans, jars, paper, or plastic products—the quality of packaging material critically affects the quality of the product and customer acceptance.

**Low Investment Cost Per Job.** Many agroindustries are labor-intensive enterprises, particularly those that have evolved from traditional crafts and do not undertake an advanced degree of processing. They are, therefore, attractive to economies with surplus, or rapidly growing, labor supplies and to those with limited savings or other sources of investment capital. But any increase in the level of technology or the size of such operations will normally require a higher capital investment per job. The size of the markets and nature of competing products will be factors to consider in investment choices.

In vegetable oil production, small rural or regional markets may be adequately served by an oilseed crushing plant that consists only of cleaning and heating operations and one or more expellers, perhaps followed by oil dewatering and filtration. To produce a higher-quality product, however, such as might be needed for export sales, a larger more capital-intensive process might be necessary, and this would override the advantages of abundant, low-cost labor supplies.

In relation to employment creation, one usually thinks of the direct costs, which consist of the investment and permanent working capital required both to establish and operate that enterprise. In addition, there will be indirect costs to take into account, which may be incurred by the government. Technical assistance to the enterprise, training services, and worker amenities that facilitate their employment at the enterprise also may contribute significant and long-term cost, especially in establishing small industries. In some cases, the cost of supporting services for small-scale industry can be at least as high as the direct investment cost per job. By using the lower levels of technology for some operations, such indirect costs may also be lower in agroindustries than elsewhere.

**Limited Economies of Scale.** Although agroindustries may offer limited economies of scale, in practice this is true of only certain types of activity. Scale is less critical for processes that have evolved from traditional crafts than for those that are the direct result of modern technology. Scale is also less significant in labor-intensive processes and in those in
which heat or mechanical force or a naturally occurring agent such as yeast are used to achieve product transformation. On the other hand, processes that use chemical agents such as solvents or refined natural agents such as enzymes normally require larger throughput to be viable.

Economies of scale are less critical when quality control is related to physical properties such as contaminants rather than to chemical properties such as degree of oxidation. And although it is a transitory factor, one should add that economies of scale are less important when a product is destined for small relatively isolated markets and is not to be marketed in direct competition with substitutes from more sophisticated industries.

**RELATIVELY SIMPLE TECHNOLOGY.** Many agroindustrial processes that have evolved from traditional crafts employ a simple technology that is well understood even in relatively nonindustrialized communities. Such activities can therefore form the first steps toward industrialization without a huge investment in education and training. Nor do they require sophisticated institutional, scientific, or technical support structures.

Even for this range of products, however, a sophisticated technology may be required in order to comply with international quality standards, because of restrictions on ingredients or contaminants, or the availability of new processing methods. In general, the sophistication of the technology will depend on several process or market factors:

- Extraction and preservation activities tend to employ a simpler technology than processes that change the basic character of raw materials.
- Mechanical processes are normally simpler than those involving chemical change or the use of catalysts.
- Batch processes are simpler than continuous processes.
- Processes performed under atmospheric conditions or with the direct application of heat are simpler than those using pressure vessels or indirect heating systems.

**Socioeconomic Analysis**

Socioeconomic analysis need not always involve extensive data collection and quantitative analysis. As J. P. Gittinger states in *Economic Analysis of Agricultural Projects* (Johns Hopkins University Press, 1982),

What we need to do here is adopt an accounting practice—the doctrine of materiality. The analyst must focus his attention on those adjustments to
For smaller investments, or investments in economies that are free-market oriented, financial analysis will usually satisfy the interests of investors. For development planners in such cases, it may be sufficient simply to adjust financial calculations for factors such as taxes and subsidies, to identify the effect of these "transfer payments" on the performance of the proposed investment. Or they may also wish to reflect widespread unemployment or depressed economic conditions in the area of the proposed investment by adjusting the cost of labor and land. In the case of large projects, or those to be located in economies with widespread price and trade regulation, a comprehensive set of quantitative and subjective analyses may be required to accurately assess development impact.

The typical economic analysis is based on three changes to the figures used in financial analysis:

1. Removal of transfer payments.
2. Adjustment for price distortions in traded goods.
3. Adjustment for price distortions in nontraded goods and services.

Once these changes have been made so that costs and benefits reflect their worth to the economy at large, they are compared over the life of the project as they would be in a financial analysis. Since the main concern in economic evaluation is efficiency over the long term, the measure most frequently used is the internal rate of return.

Adjustment for Exchange Rate Distortions

It is common for investment projects in developing countries to have some of their investment, expense, and revenue items denominated in local currency and some in foreign exchange. Before the adjustments can be made to individual prices, therefore, the analyst must ensure that the exchange rate between the currencies is appropriate. So the first step in economic analysis is to adjust the "price" of foreign exchange.

In most developing countries that control the exchange rate, the official exchange rate undervalues foreign exchange. The result is that financial analysis using market prices for imported goods and services underestimates their cost to the economy. Similarly, the price received for
exports, at the official exchange rate, undervalues that output of the economy.

The real danger of this distortion is that investments requiring imported components—typically capital equipment and intermediate goods—will be artificially encouraged, while investments that produce goods for export will be discouraged. Both of these signals will be to the detriment of efficient resource allocation within the economy, which is the principal concern of the economist. To adjust for this distortion, the economist develops a foreign exchange premium or a shadow exchange rate which is used to adjust the value of all foreign exchange transactions of the proposed investment.

To better appreciate the rationale for this adjustment, one should think in terms of the demand for foreign exchange. The economist looks for the price at which the demand for foreign exchange will be just satisfied by available supplies. Under the circumstances we have described, people who wish to purchase foreign goods and services would be willing to pay more for foreign exchange than the official price. Since foreign exchange must be rationed in one form or another when the exchange rate is controlled, not all demand for foreign exchange can be satisfied officially, and a black market may develop in which foreign exchange has a higher price. It is not correct to suggest that the economic price of foreign exchange is the black market price, because there are unique elements of speculation and risk in that market. In most cases, the economic value of foreign exchange will fall between the official and the black market rates.

The difference between the official exchange rate and the rate at which demand for foreign exchange would be just satisfied is referred to as the foreign exchange premium. It is usually expressed as a percentage of the official exchange rate. The official exchange rate multiplied by the foreign exchange premium results in the shadow exchange rate.

Suppose that the official exchange rate is four units of local currency per U.S. dollar. Suppose further that the demand for imported goods would be satisfied if the exchange rate were five units per U.S. dollar. Then,

Foreign Exchange Premium = 5:1 / 4:1 = 1.25
Shadow Exchange Rate = 4:1 \times 1.25 = 5:1.

There are a number of complex methodologies for estimating the foreign exchange premium based on different measures of demand for imported and exported goods, and they result in somewhat different fig-
ures. The flow of capital as well as goods and services must be considered in demand estimates, and the analysis should take into account the dynamic nature of these factors. Most of these methods have specialized application in macroeconomic analysis and their intricacies need not concern the investment analyst. Economists generally agree on a premium or shadow exchange rate to be applied for investment planning purposes, and it will usually suffice for the investment analyst to use published figures in adjusting foreign exchange prices for economic evaluation.

A NOTE OF CAUTION. Large exchange rate distortions signal a serious economic problem, and a burden to the government that it will probably not be able to sustain in the long term. The investment analyst should take this information back to the financial analysis and examine the impact of a possible devaluation on the proposed investment.

**Removal of Transfer Payments**

A transfer payment is a financial transaction in which no good or service is received directly in return. The most common examples are taxes and subsidies. These are financial costs and benefits, but the economist omits them because they do not reflect the use of real resources, merely a shift in the control over resources.

In a transfer payment, purchasing power is taken from one party and given to another; it is only when that purchasing power is used that the economist measures it as a cost or a benefit. For example, an enterprise may receive a subsidy to establish a distribution and purchasing center in a sparsely farmed area. While this appears on the books of the enterprise as a cash inflow, the economist argues that it is only when that subsidy is used that it has economic value. If the funds received as a subsidy are then used to purchase vehicles or refrigeration equipment to equip the center, they will appear in the economic analysis at that time.

Duties and export taxes are particularly common forms of taxation affecting agroindustrial investments. The c.i.f. price of a piece of imported processing equipment represents the value of the manufacture, marketing, and transport services that went into the delivered product. In other words it represents the use of resources and is therefore an economic as well as a financial cost. But the import duty levied on that equipment is
merely a transfer of purchasing power from the importer to the government, and is therefore excluded from economic analysis.

When an export tax is levied on the output of an enterprise, it appears as an expense (or a discount on sales) for the exporter. This is again a transfer of purchasing power, from the exporter to the government. Consequently, the financial statements of the exporter do not reflect the full economic value of output, and the economist adds back the export tax when assessing the value of the enterprise to the economy.

Adjustment for Price Distortions in Traded Goods

Two types of distortion can appear in the market pricing of traded goods: those related to the price of the foreign exchange itself, and those that result from inefficiency, regulation, or non-arm’s-length relationships, between seller and buyer. Adjusting for exchange rate distortion, which was discussed in a previous section, consists of determining and applying a shadow exchange rate to all foreign currency transactions. Determining the economic value of individual goods and services is a more complex exercise, but it is based on the same principle of what a buyer would be willing to pay in the absence of intervention.

In most cases of enterprises that actually import or export in the open market, adjusting market prices for foreign exchange distortions and transfer payments will result in a fair estimate of economic value. The real problem arises when enterprises produce a product for the domestic market that could otherwise be imported, or that buy imported goods under controlled conditions. A comparison with export or import alternatives lets the economist check on the efficiency of committing resources to the proposed investment. Could this enterprise compete against imported substitutes or does it need protection? If it needs protection, are the benefits of having the local source of supply sufficient to justify the cost of protection?

A less common case that poses the same conceptual problem is that of the firm constrained to sell all or a portion of its output in the domestic market at a lower price than could be realized in world trade. The economist will price this firm’s output at the export equivalent price and so obtain a measure of the benefit forgone by the economy by diverting that production to the domestic market.
The point of departure in economic pricing of traded goods is the "border price." For an import, this is the cost of the item, c.i.f. port of entry. For an export, it is the value f.o.b. port of departure. This approach is based on the assumption that the world market typically consists of enough buyers and sellers that the international price reflects "what people are willing to pay." The border price must then be adjusted to include the local transportation cost and any changes in form or content that would make the traded good identical to the output of the enterprise. If the locally produced good is priced higher than this adjusted border price, it will be unable to compete without protection or financial incentives.

Often natural protection barriers such as transportation costs enable local enterprises to incur higher costs than their international competitors and still remain efficient as suppliers to isolated or specialized markets. On the other hand, regulatory protection of an enterprise that cannot produce at adjusted border prices has a direct cost to the national economy. Duties or quantitative trade restrictions on competing goods have a cost to consumers in the form of higher prices; they have an administrative cost to the state; and the economy pays a cost in the form of inefficient resource allocation.

The burden of protection on the economy may be justified in terms of national security, public welfare, or support to an infant industry, but it is a cost that is coming increasingly under criticism by economists and the development community for the inefficiency and fiscal loss it has fostered. Sponsors seeking incentives or protection for a proposed investment should be cognizant of the economic benefits their investment is likely to generate, because the case for assistance will be carefully studied in relation to these benefits.

A NOTE ON INVESTMENT CODES. Investment codes are based on the principle that it is important to identify and standardize the range of incentives and protection believed to be necessary to promote investments that will contribute to economic objectives. In effect, they create financial benefits for the investor that extend to him a share of the expected economic benefits to the community. Pulling together the various incentives offered by different parts of government into a formal code permits a more accurate assessment of their value and cost to the economy, but it also permits a more consistent, transparent treatment of various enterprises.
In contrast to the ad hoc negotiation of incentives that characterizes some economies, the presence of an investment code and an established procedure for considering projects gives investors a sense that they will be treated equitably; it also gives them an opportunity to estimate the potential advantages if they avail themselves of the code, and the cost of doing so. The investment analyst should not underestimate the cost of code benefits—not simply the cost of administration, but the cost of foregone production, location, and market opportunities implicit in complying with the terms of the code.

**Adjustment for Price Distortions in Nontraded Goods and Services**

Many goods and services do not enter trade, either because they cannot compete in price with sources within the market country or because of the fear of government intervention. If the good or service in question is produced and marketed under competitive conditions, then the domestic market price is a good indicator of economic value (i.e., a number of suppliers are free to make production choices according to what they believe consumers are willing to pay, and a number of consumers are free to decide how much of the item they want at what price). Items in this category are not traded simply because they cannot absorb the transport and marketing cost, perhaps because of very low value-to-weight ratios or high perishability.

Items that are not traded because of government intervention pose some of the most difficult analytical problems in economic valuation. In general, the approach is to determine an opportunity cost for the factors that go into producing the item. What output is forgone by the economy because it has decided to support or dictate the production of the item in question?

To answer this question, the economist takes the production function—the quantities of inputs required in the subject enterprise—and values each of them on the basis of the value of what they could produce in their next best alternative use. This “marginal value product” is the opportunity cost of using the input for the subject activity. For example, if the interest on funds used in a proposed project is to be 8 percent, but capital could earn 15 percent in another investment of similar risk and duration, then the opportunity cost of capital is 15 percent, and the economist will use this rate rather than 8 percent in assessing the economic
merit of the proposed project. The approach to valuing capital, labor, and land is similar, but each has some unique considerations.

**THE COST OF CAPITAL.** The financial cost of capital is the interest rate plus explicit transactions costs in the case of debt financing. Equity in the form of share capital and retained earnings is rewarded in the form of a share of profits and therefore is not considered by the financial analyst as having a direct cost. The economist takes the view that capital, whether in debt or equity form is a scarce resource that has a cost to the economy. If it is not used in a particular project, it is available for another opportunity. It must therefore be valued in relation to its worth if it had been used in the best forgone opportunity.

The opportunity cost of capital that is relevant for a particular investment should be derived from alternatives that are similar in terms of risk and duration. In practice, a relatively risk-free investment such as a government security is taken as a general indicator of the opportunity cost for the economy as a whole, and then exceptional risk considerations can be introduced as a second step. Economists generally agree on an opportunity cost of capital figure for a country and sector; these are revised from time to time and widely available from planning offices and development institutions.

**THE COST OF LABOR.** If a worker has the opportunity of full-time employment, with or without the proposed project, and the freedom to choose where to work, then the market price of his services—his wages or salary—is also the measure of economic worth. But the presence of unemployment or underemployment in the area of the proposed investment would mean that the economic cost of that work is less than the wage rate. The principle factor in assessing economic value for labor is again the forgone opportunity for employment or productive activity.

The economic cost of permanent employees is usually determined by taking the weighted average of alternative employment opportunities over the course of the accounting period—usually a year. For example, consider the case of a worker whose salary is $5 per hour. If alternative employment is available for workers in this skill group for six months each year at $5 per hour, three months at half that rate, and not at all for the other three months of the year, then the shadow wage rate for that group of workers would be $5 \times 0.625, or $3.125 per hour.\footnote{This calculation assumes a linear interpolation for the partial years.}
The alternative employment opportunities for unskilled and semi-
skilled workers are often poor in developing countries, particularly in
rural areas, inviting significant discounts in economic analysis. But one
important exception exists for agroindustrial enterprises: Seasonal work-
ners may account for a large share of the total wage bill, and the need for
these workers may coincide with peak demand for their services else-
where in the region. Under these circumstances, even if unemployment is
widespread at other times during the year, the economic cost of labor for
the enterprise must be the full market wage rate.

THE COST OF LAND. If land has a variety of uses, and there is a rela-
tively unrestricted market for the type of land in question, then the selling
price or rental fee will be a fair indicator of its economic value. This is
often the case for land near urban centers that is being considered for
commercial or industrial purposes such as storage, processing, or market-
ing. Agricultural land poses different analytical problems: Except for par-
cels near urban centers, there is little alternative use for farmland, and in
developing countries there are often legal and regulatory limitations on
the purchase and sale of such land. For these reasons, economists usually
fall back on opportunity cost in assessing the economic value of agricul-
tural land.

The net value of the land's production in its next most productive
alternative use is taken as the economic value. Two qualifications need to
be introduced to this approach: the risk associated with the alternative
activity should be similar to that of the proposed venture, and both
should require similar levels of managerial input.

OTHER PRICED FACTORS. From time to time, a number of other priced
factors may have to be adjusted to reflect their real economic value. These
may include royalties and other charges for the use of copyrights or pat-
ents, insurance, and even intangibles such as goodwill. In all cases the
key question must be whether the financial cost (or benefit) reflects the
value of that item as opposed to an alternative use of the capital commit-
ted to its purchase. For example, would one be better off paying royalties
for a proprietary technology, or spending that amount on additional
capacity or advertising for products from an uncontrolled process? Or,

1. \[ (0.5 \times 1.0) + (0.25 \times 0.5) + (0.25 \times 0.0) = 0.625 \]
expressed differently, what is the value of the rights acquired with the royalty in terms of cost reduction or revenue enhancement in relation to a nonproprietary alternative? In the case of insurance, the premium would be an economic cost as well as a financial cost because it represents an actuarially determined share of the cost of replacing an item in the event of accident. In that sense, it is partial prepayment for the use of resources.

Valuation of Nonfinancial Factors

A number of factors that affect the operation of an enterprise are normally taken to have no monetary value when preparing a financial analysis. In the future, these factors could conceivably include such far-reaching concepts as the use of oxygen (especially for industries wishing to set up a plant in large urban areas such as Mexico City), but at present are restricted to factors such as environmental impact, the use or provision of shared services, and human resource development.

Environmental Impact. The clearing of tree cover to plant annual crops or pasture to provide raw material to an agroindustrial enterprise may produce considerable soil erosion, with follow-on damage to watersheds, the silting of dams and water-retaining structures, the loss of arable land, and flash flooding. Such damage obviously carries a cost, but it is one that generally will not be borne by the company responsible. In economic analysis, however, such costs should be attributed.

The by-products and other wastes created by the enterprise may also affect surface water and the water table, promote pest infestations and disease, and push up sewage treatment costs for the government. Again, unless such costs are borne directly by the company (which is seldom the case in developing countries), they will not appear in financial analysis, but they must be taken into account in assessing the costs and benefits of the enterprise to the economy.

Shared Use of Resources. Actions taken by the enterprise to further its own productivity may have a far-reaching impact. Positive examples might include the construction of facilities that are of use to others, such as access roads to producing areas or port facilities, or the provision of medical care and education services to employees and families. Negative examples may include increased traffic congestion on existing roads or
water shortages caused by the heavy demand that processing operations place on limited municipal supplies.

**Skills Development and Training.** Workers employed by the enterprise will develop skills, while farmers and other suppliers will increase their knowledge of modern technology and management requirements. This process of human resource development is a nonfinancial return arising from the processing operation and may require valuation should the skills development be significant (and transferable to other employment opportunities).

**Valuation of Social Impacts and Equity**

Costs and benefits arising from agroindustrial enterprises may differ in value not only according to economic prices, but also as a result of social considerations. This is perhaps the most controversial area of socioeconomic analysis, as it involves a wide range of judgments as to the "cost" or "benefit" of a particular social change or impact. Nevertheless, few would deny that large investments and projects can and often do affect the lives of those connected with them. Illustrative of these changes are the consequences of agroindustrial investment on the rural community in which raw materials are to be procured (see Chapter 4).

Two important categories of social cost-benefit valuation can be defined: the assigning of values to otherwise nonpriced social impacts, and the adjustment of the value of all costs and benefits depending upon the economic characteristics of the beneficiary. These were the focus of complex methodologies developed in the 1970s (see, for example, *Social Cost-Benefit Analysis: A Guide for Country and Project Economists to the Derivation and Application of Economic and Social Accounting Prices*, World Bank Staff Working Paper 9, 1976). But this analysis still depended on difficult subjective judgment and therefore remained controversial. As a result, economists today are less inclined to attempt to quantify social costs and benefits, but they recognize that these are legitimate concerns in project selection and ranking.

**Nonpriced Social Factors.** Like other nonpriced factors, social services—such as improved health, education, and general well-being—can
be among the benefits (or, if deteriorated, costs) associated with an enterprise. The difference between social and other nonfinancial factors lies in the difficulty of valuating them. Environmental damage, for example, can normally be costed in terms of reparations (despite the practical difficulties that may arise), but it may be impossible to agree on the value of improved health or the cost of early death.

**Equity Considerations.** Where the policy of a government or donor agency encourages development among the poorer segments of the population—or indeed, any other specially targeted group (women, youth, minorities, etc.), the benefits accruing to these groups will be considered more valuable than benefits accruing to wealthy or nontargeted recipients. In the quantitative methodologies, benefits and costs that can be traced to or from a particular sector of society are adjusted by a conversion factor that reflects the "marginal utility" of resources to this target group of the population. The complexity and the subjectivity of developing utility functions for different groups of the population were such that this level of refinement is no longer in common use.
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Agroindustry—preserving and transforming agricultural raw material—accounts for more than half of manufacturing activity in the developing world and, in its traditional form, is one of the first steps on the road to industrialization.

*Agroindustrial Investment and Operations* distills the experience of investors, managers, and researchers in the field. Among the topics discussed are:

- Steps in identifying, analyzing, and selecting the components of an agroindustrial enterprise. These sections are based on the same conceptual framework as in the second edition of *Agroindustrial Project Analysis*, by James Austin—in particular the three interdependent subsystems of marketing, processing, and raw material supply.

- Information needed to assess the financial viability of the proposed enterprise: the analytical techniques that are most useful; the criteria to be used in financial analysis; capital requirements; and the systems that will ensure the best results.

- Management, administrative, and planning activities involved in establishing a successful enterprise; the relationship between this investment and national development policy; and the availability of incentives and protection for investments that contribute to development objectives.

*Agroindustrial Investment and Operations* is primarily a guide for those who design or manage agroindustrial projects, but it may also be used in academic or professional training activities to teach the principles and methodology of agroindustrial project appraisal.