AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523
BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY
Batch 70

1. SUBJECT CLASSIFICATION

A. PRIMARY
Development and economics DM00-0000-G302

B. SECONDARY
Industries and industrialization--Latin America

2. TITLE AND SUBTITLE
Manual of industrial development,with special application to Latin America

3. AUTHOR(S)
(101) Stanford Research Inst.,Menlo Park,Calif.

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1958	323p.	ARC LAT338.012.S785

7. REFERENCE ORGANIZATION NAME AND ADDRESS
AID/TA/OST

8. SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*
(In English and French. French,267p.: PN-AAE-811)

9. ABSTRACT

10. CONTROL NUMBER
PN-AAE-810

11. PRICE OF DOCUMENT

12. DESCRIPTORS
Economic analysis
Development
Latin America
Manufacturing

Selection

13. PROJECT NUMBER

14. CONTRACT NUMBER
AID/TA/OST

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

PN-AAE-810

MANUAL OF INDUSTRIAL DEVELOPMENT

WITH SPECIAL APPLICATION TO LATIN AMERICA

June 1958
(Third Printing)

. . PREPARED BY

STANFORD RESEARCH INSTITUTE
STANFORD, CALIFORNIA

INTERNATIONAL COOPERATION ADMINISTRATION

Office of Industrial Resources

TABLE OF CONTENTS

		Page
INTRODUCTION		vii
	Part I: PERSPECTIVE	
Chapter		
I	The Purpose and Limited Scope of this Manual	1
II	The Relation of Industrial Development to Economic Well-Being	11
III	Foundations for Industrial Development	23
	Part II: SELECTING CANDIDATE INDUSTRIES	
IV	The Method of Analysis	29
V	Analyzing Demands	41
VI	Analyzing Resources	65
VII	Matching Industries to Demands and Resources	83
	Part III: TESTING CANDIDATE INDUSTRIES	
VIII	The Test of Net Return	139
IX	The Test of Integrated Development	159
X	The Test of Stability and Growth	171
XI	The Test of Balance of Payments Effects	185
XII	The Test of Social Desirability	195
XIII	The Test of Experience	199
XIV	Combining Test Results	203

APPENDIXES

Appendix		Page
A	A Comprehensive Checklist of Manufacturing Industries for Use in Preliminary Screening	A-1
B	Industry Profiles	B-1

LIST OF EXHIBITS

Exhibit		Page
II-1	Development of Manufacturing Industry in Relation to Other Aspects of Economic and Social Development . . .	12
IV-1	Stage I: Selecting Candidate Industries	33
IV-2	The Role of Industries: Linking Demands and Resources	34
IV-3	Stage II: Testing Candidate Industries	37
V-1	Procedure for Analyzing Internal Demand for Manufactured Goods	46
V-2	Procedure for Analyzing Export Demand for Manufactured Goods	48
VI-1	Outline for an Inventory of Manufacturing Resources . .	69
VI-2	Key Questions for Analyzing an Area's Manufacturing Resources	71
VII-1	Industry Characteristics Pertinent to Selection of Candidate Industries	84
VII-2	Size of Plants in United States Industries, 1947	92
VII-3	Size of Plants in British Industries, 1930 and 1935 . . .	95
VII-4	Industries Ranked in Order of Increasing Ratios of Fixed Capital to Value Added by Manufacture	101
VII-5	Industries Ranked in Order of Increasing Horsepower Per Worker	102
VII-6	Role of Labor Costs in Certain United States Industries, 1947	105
VII-7	Industries Grouped by Percentage of Skilled Workers, Foremen, and Professional Persons to Total Employees, United States, 1930	108

List of Exhibits (cont.)

Exhibit		Page
VII-8	Materials Costs in Selected Industries, United States, 1947	110
VII-9	Industries in Which Fuel and Purchased Energy Costs Exceeded Five Percent of Product Value, United States, 1937	113
VII-10	Ratio of Various Costs to Total Costs in Selected Industries, United States, 1939	114
VII-11	Industries Grouped by Their Tendency to Geographical Scatter or Concentration, United States, 1939	126
VII-12	Rankings of Selected Industries in Characteristics That Bear on Their Suitability for Newly Developing Areas	130
VIII-1	Form for Estimating Manufacturing Cost	152
VIII-2	Form for Estimating Profit and Loss, Capital Required, and Return on Investment	154
IX-1	Applying the Test of Integrated Development	160
X-1	Applying the Test of Stability and Growth	172
XI-1	Applying the Test of Balance of Payments Effects	186
XII-1	Applying the Test of Social Desirability	198
XIII-1	Applying the Test of Experience and Competition	201
XIV-1	Form for Tabulating and Combining Ratings of Candidate Industries	205

INTRODUCTION

Few problems are receiving as much attention throughout Latin America—indeed, throughout the world—as the problem of economic modernization and development. Even in areas where poverty, sickness, and ignorance have been more or less accepted in past generations as the normal lot of most men, peoples and governments are now manifesting a new or much more urgent concern for economic and social progress. Journalists, statesmen, and students of public affairs whose business it is to observe such movements speak of a "ferment," a "revolution of rising expectations," a "will to develop," that is one of the most profoundly important economic, social, and political facts of our age. The kinds of action to which all this leads, the success or failure of the development efforts that are being undertaken, and the gradual fulfillment of the new hopes that are so widespread--or, alternatively, their disappointment and frustration—are fraught with the most vital significance for all of us. In the opinion of many thoughtful observers, the current attempts in economically less-developed countries to catch up with modern production methods have implications that go far beyond economics and standards of living. The direction these efforts take and their outcome are likely to have as much to do as any other factors with the future of freedom, security, and human dignity in the world, and with the very survival of the community of free nations.

The new determination to do something about poverty is accompanied by a realization that a fundamental attack on poverty must proceed by introducing modern, efficient methods of production to replace outmoded, inefficient methods. This has led to the creation during the last decade or two of official development agencies and development corporations in many countries; to the launching of comprehensive programs of modernization in agriculture, education, health, and industry; to the technical assistance programs of the United States and the United Nations and to the appreciative response accorded them; and to an increasing tendency lately on the part of quite a number of countries to re-examine their attitudes and laws concerning private foreign investments, with the object of finding ways to attract outside capital and technological skills which can play a constructive role in economic upbuilding.

A major endeavor of development programs throughout the world and particularly in Latin America is to build up modern manufacturing industries. This is the aspect of development efforts in which it is hoped that the present volume may be of assistance.

Stanford Research Institute was requested by the Institute of Inter-American Affairs of the Foreign Operations Administration to prepare a Manual which would state the factors that ought to be considered when reaching a judgment as to the industries that would most effectively contribute toward raising the level of living in a country in the early stages of economic development. It was specified that the Manual should show how to take account of consumption habits and patterns in the country, natural resources, human resources, and present and potential foreign markets. It should also show how to give appropriate consideration to the major requirements for successful operation of different industries, such as the scale of output necessary for reasonably efficient operation, the needs for supplies of various kinds, and the needs for marketing facilities.

Businessmen and government agencies have often had to make practical decisions which involved selecting certain industries to be undertaken in a developing country. But the principles and methods for making such a selection on a rational basis have not often been subjected to serious study. True, academic economists have worked out useful general principles such as the doctrine of "comparative advantage"; and engineers have developed rules of thumb which summarize a great deal of practical experience in textiles, chemicals, steel, or other branches of manufacturing and which help to forecast costs, break-even points, and profits under given conditions. But the broad theories of the economists are often too general to be very helpful to those who have to make concrete, practical decisions in development, while the recommendations of industrial engineers are likely to relate to one or two industries with which the particular engineer is familiar (rather than a comparison among many possibilities) and to be based on conditions and practices in industrially advanced countries. There would seem to be need for a usable guide which attempts, as this one does, to build some bridges between the general theory of economic development and the practical decisions that managers and planners of development must make in choosing what industries to launch.

Because the task undertaken in this Manual has not been attempted before (so far as we can discover), the result has some of the earmarks of a pioneering effort and should be regarded as preliminary and tentative. If the Manual proves useful enough to justify later editions, it should be possible to improve it in many respects. This has been a one-year undertaking, and in that time it is obviously not feasible to pursue all the worthwhile leads which characteristically appear in the course of a project such as this. Two lines of practical research in particular that would seem to warrant future effort will be mentioned.

The first is to meet the need for conveniently accessible and readily comparable information on industry characteristics. As our analysis has progressed, this has more and more emerged as crucial. We have found that information on the economic and technical requirements for successful operation of particular lines of manufacturing, covering points like the size of the market necessary for an efficient scale of production and the principal resources that must be considered in estimating costs, is extremely scattered and fragmentary.

There is no simple way by which businessmen or government officials confronted with the necessity to decide what lines of manufacturing should be undertaken next in a developing country can get an over-all view of the possibilities and main requirements of each industry to be considered. In consequence, they may simply follow the traditional lines, which may or may not be best, or they may seize upon some superficially appealing new idea without realizing what they are getting into, and without weighing other possibilities that may be better.

Those who need industry information for area development purposes are only able to pick it up hit-or-miss, some of it reliable and much of it not, some of it related to the special problems of industrially less-developed countries and most of it not, hardly any of it presented in a way to facilitate the comparisons among different industries which is essential in making a rational selection of the best industries for introduction into a developing country.

In this Manual we have been able to do the following toward meeting this need:

1. Give guidance on the key questions that ought to be asked and answered about any manufacturing industry that is being seriously considered.

2. Suggest sources of information that are generally useful.

3. Present a number of specific "Industry Profiles."

The Industry Profiles, which appear in Appendix B (bound separately) provide concrete information on the salient economic and technical characteristics of certain lines of manufacturing likely to be of interest in areas that are at the stage of development of some of the Latin-American countries. More important, these few profiles may serve as patterns or models which will help users of the Manual

to assemble similar information about other lines of manufacturing that most concern them. Perhaps at some future time it will be possible to supplement this Manual by assembling a much larger number of Industry Profiles and issuing them in a form conveniently usable by area development staffs.

A second field in which further practical research is needed, in order to assist those concerned with the planning of industrial undertakings in developing countries, relates to the problem of anticipating correctly the growth of demand for various kinds of products as the whole economy grows. The more accurately demands can be anticipated, the more smoothly they can be met. Fewer false starts will be made by developing the wrong industries, and there will be less waste of scarce resources. Better advantage will be taken of the really promising opportunities for industrial expansion, resulting in a more balanced and productive type of development. We discuss the estimation of future demand in Chapter V and offer practical suggestions. It would probably be very helpful to public agencies and private businessmen in economies where rapid change is going on to have detailed factual information on the past growth of demand for various products in other economies that have experienced rapid growth. The collection, analysis, and presentation in usable form of information of this type from a variety of countries and regions would be a considerable task, but not an impossible one. Data will no doubt continue to become increasingly available as more and more countries, international agencies, and research groups confront the problems which arise in guiding industrial growth. This is another field in which it might be desirable to amplify or supplement the present Manual.

A word about the use of the term "industry." It is often used herein synonymously with "line of manufacturing" and "type of manufacturing." This is not a very precise usage, for it may refer to the production of one or a few products or a wide range of related products. But in the context the reader will know how to interpret it.

Part I

PERSPECTIVE

Chapter I

THE PURPOSE AND LIMITED SCOPE OF THIS MANUAL

Some of the countries of Latin America are in process of rapid industrial development and others appear to be on the threshold of such development. The same may be said of many other countries throughout the world where the problem of economic advancement is in the foreground of national consciousness. It is the purpose of this Manual to contribute to the economic progress of these countries by helping them to deal more effectively with some of the crucial development decisions that must be made. The problem on which we shall try to offer guidance is: How can a rational selection be made of the specific types of manufacturing industry likely to be most effective in raising the productivity and the living level of an area under development? The Manual aims to make this contribution, not by analyzing the industrial development opportunities and problems of a particular country or region, but by proposing a method of analysis. This method is applicable, with appropriate variations, to any area.

Industrial Interests of Newly Developing Countries

It will be assumed in this Manual that the industrially less-developed areas are best served by those types of industrial growth which do the most to raise the general level of living. It follows that the best industries will be those which most effectively add to the economic output of the country and thus result in a larger national product available for consumption. Such industries must be well adapted, on the one hand, to the needs and market demands in the country (and in outside markets accessible to it) and, on the other hand, to the resource situation of the country, including material resources and human or social resources.

When a country has a low level of living and is striving to raise that level by introducing modern manufacturing and other modern methods of production, it cannot afford to waste its resources. Indiscriminate encouragement of any and every kind of manufacturing, including kinds that can operate in the country only at very high costs, may bring serious wastes of resources. On the other hand, encouragement at each stage of development of well-selected industries that are truly adapted to the circumstances of the country will economize resources and make for speedier advancement in living levels.

Such scarce resources as investment capital and the energy of enterprising persons, good managers, and skilled workers, usually lacking in industrially inexperienced countries particularly need to be economized. Some mistakes and false starts are unavoidable; they are part of any learning process. But mistakes are very costly when they misdirect a country's capital and labor into expensive plants that can operate only with a perpetual government subsidy, or with the aid of long-continued import restrictions that force the country's consumers to pay more than they would otherwise have to pay for equivalent products. Misdirected industrial developments may also cause other and better industrial opportunities to be neglected, thus blocking a real increase in the national product and in the economic well-being of the people. There is much to be gained, therefore, by exercising the best possible foresight so that the manufacturing industries which are started will have the best chance to prove economically sound and beneficial.

Interest of the United States in Productive Development

We have been speaking of the interests of the countries seeking industrial development and of the benefits of such development to them.

But the United States, too, has an interest in the growth of well-adapted, economically efficient manufacturing industries in Latin America and other industrially newly developing areas; the reasons are far-reaching and practical. Its position regarding the economic and social progress of the other countries of the Free World has been officially recognized. Congress declared in the Act for International Development (1950) that it is the policy of the United States "to aid the efforts of the peoples of economically underdeveloped areas to develop their resources and improve their working and living conditions" by methods which "contribute to raising standards of living, creating new sources of wealth, increasing productivity, and expanding purchasing power." The underlined words are especially significant to the topic of this Manual. Well-selected industries do contribute to raising standards of living, creating new sources of wealth, increasing productivity, and expanding purchasing power; while badly selected ones do not.

Aside from its interest in the social and political aspects of development, from an economic standpoint the interests of the United States could be harmed by the "forced" expansion of ill-chosen industries in any country, because such industries do not

add to a country's income and buying power, because they may hamper economic and social progress and thus make for instability, and because they are likely to add to the pressures in the world that block international trade.

The view is sometimes advanced that it is contrary to the economic interest of the United States, itself a leading industrial country and a large exporter of manufactured goods, to encourage the development of manufacturing in industrially less-developed countries. This view, however, is on the whole unsound—if the manufacturing industries so developed are well adapted to the local situation and truly help to raise incomes and purchasing power. It has been well said that:

> Underdeveloped countries endeavoring to build up industries producing for their own market are often regarded as moving towards a state of self-sufficiency. But the size of the market is not fixed. When, for example, a country that consumes annually a certain number of shoes.... all of which it imports, decides now to set up a domestic shoe industry producing just that number a year, it seems natural to conclude that it is making itself self-sufficient in shoes. But if the new shoe industry is a part of an over-all process of growth, the market for shoes in that country may increase ten-fold, so that its shoe imports are increased instead of cut down to nothing. In Canada, for example, textile manufacturing was one of the first industries to develop, with the aid of tariff protection from 1879 on; yet Canada today is one of the world's biggest importers of textile manufactures.[1]*

Canada provides an instructive example of the effects on the United States of industrial development elsewhere. That country is in some ways a competitor. It has many of the same advanced industries that we do and is rapidly developing others. It now makes many of its own manufactured goods. But Canada is also one of the very best customers of United States industries. Because Canadians have high real incomes (partly as a consequence of industrial development) they buy and import great quantities of goods, including manufactures. Canadian imports from the United States were $2,700,000,000 in 1952. Bolivia and Colombia together, with about the same number of people as Canada, but with much less

---

* Symbols refer to numbered references at the end of each chapter.

advanced economic development and relatively few and weak manufacturing industries, bought only $257,000,000 worth of goods from the United States. Is it better for the United States to have countries like Canada as trading partners and neighbors in the world, or countries on a lower level of industrial productivity and purchasing power? The answer, both on political and economic grounds, would seem to favor the Canadian type of situation.

Experience shows that, by and large, when the channels of trade are not too clogged by tariffs, quotas, and exchange restrictions, the countries which produce the largest quantities of manufactured goods for themselves are also the best buyers of the manufactured goods of other countries. This is mainly because of their higher incomes. For the evidence, and for further discussion of this and related points see two references cited at the end of this chapter. (2)

The key question is: Does the new industrial development in a developing area contribute to over-all economic growth, so the country's economy becomes able to produce more, consume more, and buy more? Or does it, on the contrary, waste resources because of excessively high costs of production and thereby lower the country's power to produce, consume, and buy? This makes clear the economic interest of the United States in well-chosen, truly productive types of industrial development in Latin America and other areas with which we trade.

To Whom Addressed

In preparing this Manual we have had the following users in mind:

Officers and field representatives of the Institute of Inter-American Affairs concerned with planning and conducting programs of technical assistance in Latin America. They have expressed a desire for a practical guide to help them in the programming aspects of their industrial development work. It is also hoped that the Manual will be useful to United States officials and field missions concerned with development problems in other parts of the world.

Public officials in Latin America (and also other regions of the world) who are engaged in programs designed to forward the industrial and general economic development of their countries.

In some countries government departments or government-financed development corporations directly launch and manager some of the new industries which are desired. In practically all countries, except those under Communist rule, governments endeavor by a variety of devices to stimulate and encourage the growth of private industry. In both cases correct ideas on the type of industry likely to prove most suitable in a given country will be important to the success of development programs, and a Manual such as this may be helpful.

Businessmen of the developing countries and United States investors who may be considering the advisability of establishing or expanding industrial enterprises in these countries. In the calculations of private businessmen, first place has to be given to the costs and profits of their individual firms. The calculations of government development agencies are properly concerned with a broader view of costs and benefits affecting the entire nation. Nevertheless, many elements in the two types of calculations are identical. (Chapter VIII contains an analysis of their similarities and differences.) Methods recommended in this Manual for estimating markets and costs, together with the information provided on specific industries, should help businessmen to canvass the possibilities for private industrial undertakings and to make a preliminary selection of the lines of manufacture that are likely to warrant practical action.

Decisions That Shape Industrial Development

We shall often speak of "selecting" the manufacturing industries most suitable for a country and "determining" the sequence or priority in which it is advisable to undertake various industries. Perhaps this may suggest to some the erroneous impression that the Manual assumes an authoritative central planning body within each country which will decide what industries are to be started or permitted. Others may see in this way of speaking, equally erroneously, a hint that some agency from outside the developing country will or should attempt to impose a foreign will--as by so-called "imperialist" pressures from the government or business firms of the United States, which unfriendly propaganda sources imagine in every action. Neither of these things is implied. To forestall such false impressions it will be well to ask and answer the question, "Who, then, is expected to do the 'selecting' and 'determining'?" The assumption on which the Manual rests is as follows:

In every Latin-American country the course of the country's industrial future will be determined partly by the play of impersonal "market forces" operating through supply and demand, partly by more or less haphazard political influences, and partly by conscious decisions related to a program of development.

Some of the controlling decisions will be by public agencies, others by private firms and individuals. The most influential decisions will be made in the country itself, but external market forces and the actions of foreign governments, intergovernmental agencies, internationally operating business firms, and foreign investors are bound to influence what can be done locally. In other words, no one central agency and no specific group of persons is expected to do all the "selecting" and "determining." The process is one to which many will contribute. The exact combination of influences that decides what industries will be undertaken and what industries will not be developed is bound to vary considerably from country to country, depending on the political and economic institutions of the particular country and its international relations.

Decisions by all the following agencies and groups will, in practice, have an influence—large or small depending on circumstances--in determining whether or not modern industry develops in a given country, which particular industries develop, and in what order.

Government agencies in the developing country. Development corporations or development banks in some Latin-American countries initiate industries themselves, or lend money to private parties for the purpose. Governments grant or withhold tariff protection, special tax favors, foreign exchange permits, and franchises or concessions. They are largely responsible for the location of roads, railroads, and power facilities, and for programs of basic and technical or vocational education. Decisions made in all these connections are likely to encourage some kinds of industry and discourage others.

Private firms or individuals in the developing country. Decisions to invest or not to invest in manufacturing industries, and which lines to favor, are made by established commercial firms and by individuals of means. Ambitious young men decide whether to seek one type of career or another. Local banks encourage or discourage various types of industry by their loan policies.

Governmental and intergovernmental agencies abroad. The United States government cannot avoid influencing the direction of industrial development in Latin America through its tariff policy, policy on foreign procurement of military or other items, loan decisions of the Export-Import Bank, and the nature and extent of its technical assistance program. The policies of other governments likewise have an impact, varying with the extent of their

economic and other relations with the developing countries. Intergovernmental agencies, such as the International Bank for Reconstruction and Development, the Technical Assistance Administration of the United Nations, and the various United Nations specialized agencies cooperating in the Expanded Programs of Technical Assistance, exert an influence on development patterns through their response to requests for aid and through their advice.

Private firms and individuals abroad. Trading firms from the United States and other foreign countries, banking organizations, professional consulting firms in industrial management and engineering, equipment suppliers, and investors, by their decisions to risk or not to risk specific undertakings and by the advice they give to clients, influence the course of industrial development in Latin America.

It is hoped that this Manual will be of some assistance to all these different decision-makers. It should provide them with a framework of analysis which will help them to appraise industrial possibilities more realistically from their different points of view.

Scope of the Manual

Our analysis will focus rather sharply on one problem among many connected with economic development: How to select the most suitable kinds of manufacturing industry for introduction or expansion in a country embarked on industrialization. A number of closely related problems will receive little or no attention. This does not imply that they are any less important.

One such problem is how to determine the broad strategy of a national development program. Every developing country is faced with the problem of making the best use of quite limited resources. Not only are savings, foreign exchange, skilled labor, and materials usually scarce, but so are the time and energy of the relatively few trained and enterprising people capable of serving as administrators, managers, and technicians. In order to raise the country's living level most effectively, what part of these scarce resources ought to go toward the improvement of education and health, how much into transport and communication, how much into opening new land to cultivation or providing agricultural extension services, how much into power, mining, trade development, or financial services, and how much into the development of manufacturing enterprises? Governments have to make decisions on aspects of this broad problem when they make

development plans and budgets. Also, in somewhat different ways, businessmen and financial institutions that have broad interests make decisions which affect the allocation of funds and efforts to the various sectors of national development.

We cannot attempt in this Manual to consider in any detail the principles and procedures which should guide these over-all decisions. The general remarks in Chapters II and III are pertinent to the problem, and to some extent the tests of suitability we shall present for use in selecting manufacturing industries may be suggestive. But our main analysis will begin by assuming that a foundation for modern economic development has been laid or is being laid in the country concerned, and that needs and resources exist for at least some growth of manufacturing. The problem then is to arrive at a list of suitable manufacturing industries and to rank them roughly in order of their probable contribution to the economic advancement of the country and the well-being of its people. How rapidly the manufacturing sector as a whole expands, and how far down the rank-order list of suitable industries it will be desirable or possible to go in establishing new kinds of manufacturing in the next few years, will be determined by the amount of capital, managerial talent, and so on available and by the competing claims of the other sectors of development we have mentioned.

Another problem which we do not deal with in the Manual is how governments, trade and industry associations, and other organizations, can most effectively promote the growth of manufacturing industries, once they have decided that manufacturing dedelopment is needed and have arrived at some idea of the kinds of manufacturing that would be suitable. Many devices have been tried, among them protective tariffs, direct subsidies, tax favors, offers of free or low-cost buildings or other facilities, information services, vocational training, research and development institutes, and direct government operation of pioneer industries, with or without subsequent transfer to private management. It would be possible, and probably quite illuminating, to study the operation of these and other devices in various countries and regions and local communities that have tried them. A critical appraisal would help others to foresee the advantages and disadvantages of particular methods. It seems likely that some methods in common use are ineffective or even self-defeating in many circumstances, or do unnecessary harm to other portions of the country's economy or to its neighbors and trading partners. On the other hand, some of the more positive methods that have been experimented with successfully in a few places are not as widely known or used as

they should be. Perhaps in a future edition of the Manual, if its utility proves great enough to justify one, or in a supplement or supplements, it will be possible to deal with this subject.

REFERENCES, CHAPTER I

1. Nurkse, Ragnar. Problems of Capital Formation in Underdeveloped Countries. Oxford: Basil Blackwell, 1953, p. 22.

2. League of Nations, Economic, Financial and Transit Department. Industrialization and Foreign Trade (prepared by Folke Hilgerdt). Series of League of Nations Publications, 1945. II. A. 10.

   Staley, Eugene. World Economic Development: Effects on Established Industrial Countries. Studies and Reports Series B, No. 36. 2d. ed., 1945. Montreal: International Labour Office, 1944. A Spanish edition has also been published.

Chapter II

INDUSTRIALIZATION AND ECONOMIC WELL-BEING

We are concerned in this Manual with development of manufactures. That is only a part, though an important part, of the broader process called industrialization. Industralization in turn is only a part of economic development, which is only a part of social progress. (Exhibit II-1.)

Industrialization, in the broad sense used here, is best defined as the rise of a whole system of production in which the chief characteristics are:

Use of power-driven machinery
Sophisticated technology
Large capital investment
Extended specialization and division of labor

The industrial system of production rests on wide markets and supply sources and a complex, large-scale organization of human relationships. Therefore, we may also list as essentials of industrialization:

A money economy
Efficient transportation and communication
A system of government able to provide public order and the services essential to industry and trade
An educated population (as compared with preindustrial societies, at any rate)

No single index can adequately sum up the degree of a country's industrialization in this broad sense, though an indicator often used is the proportion of the country's working population engaged outside agriculture.

The political and business leaders of many countries that have recently entered upon the path of modern development are seeking to promote industrialization, and particularly to encourage the growth of manufacturing industries. They do so for a number of reasons. One is that they see in industrialization an essential means for overcoming the chronic poverty of their countries and for achieving, eventually, levels of living closer to those of the industrialized countries of Western Europe and North America. The relation of industrialization to productivity and living levels

EXHIBIT II-1

DEVELOPMENT OF MANUFACTURING INDUSTRY IN RELATION TO OTHER ASPECTS OF ECONOMIC AND SOCIAL DEVELOPMENT

SOCIAL PROGRESS

Advancement in terms of broad human values — gains in health, education, self-government, individual freedom, security, creativity, and other values that contribute to human dignity.

A part of social progress is:

ECONOMIC DEVELOPMENT

Increase of productivity and living levels, resulting from more efficient agriculture, commerce, and industry.

A part of economic development is:

INDUSTRIALIZATION

Rise in nonagricultural occupations and in use of machinery, advanced techniques, specialization, transportation, power.

A part of industrialization is:

DEVELOPMENT OF MANUFACTURES

Rise of factory production.

will be examined more particularly below. Also, these leaders know that industrial skills and equipment are very important factors these days in a nation's military strength for defense or offense. Furthermore, prestige in the community of nations is often, rightly or wrongly, linked to industrialization. Among the most powerful motives spurring newly developing nations to industrialize is their desire for status and respect—the wish no longer to be thought of as "backward," weak, second-class countries. We mention these reasons of a political and psychological order only in passing, though they are certainly of first-rate importance. Our principal concern is with the use of industrial development to advance living levels.

Level of Living

The term "level of living" as used here means a composite of:

Goods and services consumed. The amount and quality of food, clothing, housing, health services, educational services, recreational services, and other goods and services consumed on the average by families and individuals.

Surrounding conditions. Leisure time (length of working hours), good or bad working conditions, stability or instability of income, and possession of reserves for meeting the economic shocks of life, or lack of such reserves.

Also pertinent to the level of living in the broadest sense are such things as the presence or absence of political and economic freedoms, the prevailing atmosphere of human relations, and the hope of progress, or lack of it. However, our analysis will be mainly concerned with the material aspects of living levels, summed up in the two points above. *

---

* What is here called "level of living" is often popularly referred to as "standard of living." In precise usage, however, it is desirable to distinguish what is actually experienced, enjoyed or suffered (the level of living) from what is expected or urgently desired or striven for (the standard of living). On the use of these terms, as well as for an excellent discussion of economic levels in relation to the whole content of living, see Reference 1 at the end of this chapter.

The amount that a country produces, divided by the population in that country determines to a fairly close approximation what its material level of living can be. The actual level will be higher or lower than the production per person depending on:

How much of current production is going into investment rather than into consumption.
How much is being used for military purposes.
How much is being paid to or received from other countries.

If a manufacturing industry adds to the national product of a country, then it makes possible an increase in the level of living. It will add to the national product if the total amount produced by the industry, plus any indirect increase its presence may bring about in the production of other industries or other segments of the economy, is more valuable than the real cost of the resources it uses up. (The real cost of the resources used in an industry can be thought of as an "opportunity cost." That is, using the resources to make shoes means that the same labor, capital and so on are no longer available to make furniture or bridges.) An industry may also add to the level of living by providing good working conditions, by stable employment, and by exerting a generally constructive influence on the community around it.

What we want to develop in this Manual is a set of practical procedures and tests by which to make a reasonable judgment, in advance, as to the probable contribution of an industry to the living level of the country. Will it make a positive contribution? Will it contribute as much as certain other industries that are also under consideration? Where there are limited amounts of capital available for industrial investment and fewer skilled managers and workers than are needed, this last question is a crucial one. An industry, to be suitable for a developing country, must not only give good promise of adding to the national product and therefore of making possible a higher level of living, but must also promise more than could be had by using the same scarce resources in some other way.

Cautions

It would be unfortunate if our concentration in this Manual on one set of problems in economic and social development were to give a false perspective in a field where many equally important problems are intertwined. Industrialization, and even more that aspect of it which consists of the growth of manufacturing, is no

cure-all for poverty or for other economic and social ills. In many countries that are striving for economic advancement there is a least as much to be gained at the present stage by working to improve agriculture and commerce. Economic well-being is best raised by increasing productivity all along the line, in every type of activity, and by emphasizing those activities most suitable to the needs and resources of the country. There is no magic in manufacturing as such.

Also, it is advisable to bear in mind that industrial development, while it may bring important social gains when suitably carried out, can bring social evils. The slums that have arisen in some industrial cities may be as undesirable, in terms of human well-being, as rural poverty.

There is sometimes a tendency in less-industrialized countries to idealize smoking chimneys, and to assume that the high living levels of the United States can be explained in terms of Pittsburgh and Detroit. This overlooks the role of modernized agriculture—as different from preindustrial, peasant agriculture as factories from handicraft. It also underrates many cultural factors which help to account for the high United States productivity such as a system of public education that gives educational opportunity to every person.

Industrialization and Income

Statisticians have found a fairly close correlation between a country's degree of industrialization (as measured by the proportion of the working population occupied outside agriculture) and the level of its real income per capita.[2] This may result partly from the way the statistics are collected. The income of subsistence farmers is likely to be less fully reported or is undervalued as compared with urban incomes. Nevertheless, it does seem to be true that, in general, a higher degree of industrialization goes with a higher level of average income, and a lower degree of industrialization with a lower level of average income.

This proves association between industrialization and relatively high incomes, but tells us little about cause and effect. It does not necessarily mean that industrialization causes high incomes. It could just as well mean that high incomes cause industrialization. Or that both high incomes and industrialization are results of certain other factors that have been at work in some countries and not in others. Acutally, as will be shown, there are reasons for thinking

that all three types of linkage help to account for the observed association between industrialization and high average income

The fallacy in reaching conclusions about cause and effect from mere statistical association and then proceeding to base development policy on such conclusions can readily be illustrated. If we study the number of physicians and dentists per thousand people in different countries and the average income levels of the same countries we find a fairly close correlation—probably closer than the correlation between industrialization and income. A close correlation between the number of beauty parlor operatives and income levels could probably also be demonstrated. Yet this does not mean that the way to raise a country's real income is to increase the number of physicians, dentists, and beauty parlor operatives.

The true relation between industrialization and economic progress as measured by income levels is complex:

In part, industrialization is a consequence of increased income. Better methods in agriculture, or more efficient exploitation of mineral and other resources saleable in the world market, may bring a rise in per capita income. As incomes rise, the demand for manufactured goods and for various urban services will also rise. This demand is likely to rise more rapidly than the demand for staple foodstuffs (agricultural products). That has been the almost universal experience, once incomes have risen past the level needed to meet the subsistence needs for food. A consequence of this shift in relative demand as incomes rise is to encourage expansion of nonagricultural occupations—which means to encourage manufacturing and other aspects of industrialization. Thus, industrialization is partly a result of improvements in agriculture. The higher incomes generated in an improved agriculture create the market for manufactured goods—for tools, implements, fertilizers, and for shoes, textiles, and radios. The same point may be put in another way. A more efficient agriculture enables fewer farm workers to produce the same or a larger amount of farm products. Thus, it becomes possible for an increasing number of workers to turn to producing goods that satisfy other wants, without lessening the output of food and other products from the land. That is, nonagricultural industries can develop.

Industrialization can also be a consequence of higher incomes because higher incomes make it possible to save and invest more capital. Industrialization requires large investments in roads and

railroads, power stations, factory buildings and machinery, educational facilities, and so on. It does not follow, of course, that a rise in a country's income level will necessarily lead to such investment.

In part, industrialization is a cause of increased income. The new methods of production comprised in industrialization, if well applied in industries suitable to the country, will enable it to make better use of a wider variety of resources. That is, the country is in a position to make better use of natural resources such as minerals and of the aptitudes of its population. Resources are likely to be more thoroughly explored and more effectively put to work. In this way industrialization can raise productivity and bring higher average income.

Some less-industrialized countries have a true surplus of agricultural labor, meaning that the same farm output could be produced by fewer farm workers, even without drastic changes in techniques. This is especially likely to be true in densely populated countries. It is the case in Puerto Rico, for example. In such a situation it may be impossible to do much toward improving the efficiency of agriculture without at the same time finding off-farm occupations for a considerable part of the population—that is, without industrialization. Otherwise efforts to increase the size of small, fragmented farm holdings and to introduce labor-saving devices would increase the amount of chronic unemployment and underemployment and run against insurmountable social obstacles. Where these conditions prevail, industrial development must precede or at any rate run parallel with gains in agriculture. In these circumstances industrialization is likely to be an essential precondition of any substantial, permanent increase in income levels.

The rise of industries and towns is a powerful factor in "breaking the cake of custom" and loosening the bonds of traditional institutions that tend to perpetuate old, inefficient methods of production and distribution. Also, where excessive population growth acts as a handicap on efforts to raise income levels those influences which lead people to have smaller families may be important in the long-range prospects for economic advance. Experience shows that industrialization and its attendant urbanization are such influences.

In part, industrialization and increased income have common causes. More advanced technology in agriculture, which helps to increase the real incomes of farmers and city people alike, also

requires increased use of equipment and supplies that have to be produced off the farm. Modern agriculture, like modern production generally, is more and more "roundabout." That is, workers in plow and tractor factories, on railroads that haul farm products and farm supplies, in grain elevators and brokerage offices, in agricultural experiment stations and the editorial and business offices of farm publications, are in effect producing agricultural products, yet they are not on the farm. Thus, even without the shift in relative demand from farm goods to other goods as incomes rise, the adoption of modern technology brings a decrease in the proportion of workers who work directly on the farm. The same technological changes which help to increase income also help to shift workers from agriculture to manufacturing and service trades, with the result that the association between industrialization and higher real incomes is further strengthened by the operation of this common technological cause.

Conclusions

We have shown above, some, but by no means all, of the complex interrelations which account for the observed fact that high levels of real income and high levels of industrialization tend to go together. Three things are clear from this analysis:

First, industrialization, in the broad sense in which we have defined it, is a necessary characteristic of any long-sustained economic advance by a country which starts from the typical "underdeveloped" situation—that is, from poverty and from a technically backward, predominantly agricultural economy.

Second, while an increase in real income creates a favorable situation for industrialization, by providing an internal market and a greater potential supply of capital, it does not necessarily bring a marked rise in industrialization. The potential demands of consumers and the potential capital supply made possible by a rise in incomes (originating, say, in agricultural improvements or in a fortunate market abroad for the country's coffee or oil) may not lead to substantial industrial growth because social tradition may frown on new enterprise, because those who receive the new income prefer to spend it on land or on luxurious trips abroad, because poor educational opportunities restrict the supply of skilled labor and skilled managers, or for other reasons.

Third, while industrialization properly carried out can greatly increase a country's real income, not all efforts at industrialization have this result. Industries may be undertaken that are poorly

adapted to the country's circumstances, either in terms of the market for the product, the resources required, the feasible scale of operation, or the timing. Or industries may be inefficiently managed. Or they may be devoted to military and political-power purposes rather than to the advancement of economical well-being.

In addition, our analysis has brought out certain points that should affect the timing of efforts to improve agriculture, on the one hand, as contrasted with efforts to develop manufacturing. In countries where agricultural overpopulation is not a problem, improvements in agricultural efficiency may have to come first, or at least must come along with the rise of city industries. Otherwise the manufacturing industries will have small markets and high unit costs, and there may be food shortages. But in countries where there is much underemployed agricultural labor the improvement of agriculture may quickly run into obstacles unless there is prior or parallel development of nonagricultural industries and trades. Thus, industrialization and agricultural improvement complement each other, and a lag in either may limit the other. The two together, in proper balance depending on a country's circumstances, jointly offer the best prospect of sustained advance in living levels.

Theories which claim, without concrete analysis tied to a particular place and time, that some broad class of economic activity, such as manufacturing, is more productive than some other broad class, such as the primary raw material industries or agriculture, must be viewed with skepticism. If allowed to influence practical policy, they are likely to mislead and bring needless waste of scarce resources in a country's development.

Such doctrines have in fact had a harmful influence on economic policy in various countries, including some in Latin Amercia, by encouraging a rather indiscriminate promotion of manufacturing industry and a neglect of equally important opportunities to advance productivity in agriculture. In some countries agriculture has even been taxed or penalized by price manipulations in order to subsidize manufacturing industry. The productivity of manufacturing industry depends, among other factors to be examined in more detail in subsequent chapters, on the size of the market for its products. In a country where agriculture must for some time continue to be the dominant occupation, this means that many lines of manufacturing will be so costly and inefficient as to be harmful to the country's living level rather than helpful so long as agriculture remains poor. On the other hand, agriculture may

remain poor indefinitely without the stimulus and aid which suitable types of manufacturing can bring. The kinds of manufacturing development that are encouraged, their proper adjustment to internal and external markets, and their timing in relation to progress in agriculture and other sectors of the country's economy, will have much to do with determining whether industrial development makes the contribution that it should to the advancement of living levels.

REFERENCES, CHAPTER II

1. Davis, Joseph S. "Standards and Content of Living." American Economic Review, March, 1945, pp. 1-15.

2. Clark, Colin. The Conditions of Economic Progress. 2d. ed. London: MacMillan, 1951. Chapter IX.

3. Bean, Louis H. "International Industrialization and Per Capita Income." Part Five, pp. 119-143 of Studies in Income and Wealth, Volume Eight. Conference on Research in Income and Wealth. New York: National Bureau of Economic Research, 1946.

Chapter III

FOUNDATIONS FOR INDUSTRIAL DEVELOPMENT

Manufacturing industries will contribute to the desired rise of living levels in a developing country if they are well chosen and operate efficiently—that is, if their costs are low in relation to the value of the product they turn out. Industries that are inefficient and operate at high costs, on the other hand, instead of helping to raise the general level of income may act as parasites on the rest of the economy and actually retard economic advance.

Whether industries will have low or high costs, and therefore whether they will be productive or parasitic, depends on many factors. One is the selection of the right industries for development. The most productive industries will be those whose requirements for markets and resources are well suited to the conditions of the country. But not only do particular industries have their special requirements, there are also certain general requirements that affect the prospects for successful operation of practically all manufacturing industries. We may refer to these as foundations for industrial development.

In the absence of sound and substantial foundations for industry in general, practically any line of manufacturing that is attempted in a country will turn out to be inefficient and costly. Manufacturing industries will be able to exist only by charging consumers more than the consumers would need to pay for similar goods from abroad (possible under protective import regulations), or by some direct form of subsidy, or by paying very low rewards to the labor, capital, or management employed.

The foundations needed for truly productive growth of manufacturing industry include basic utilities and services, natural resources development, human resource development, and the development of "organizing factors." These requisites will be briefly surveyed.

Utilities and Services

Transportation. Probably the greatest obstacle to modern manufacturing in newly developing countries is the small size of the market. In the first place, low incomes limit the sales of manufactured goods. But even where a fair-sized market might exist if it could all be tapped, country-wide, the potential market

is often broken up into local segments by lack of transportation, or by excessively costly or undependable transportation. Therefore, a manufacturing plant can serve only a very limited market, and in those numerous lines of manufacturing where low cost depends on at least a moderately large volume of operations, costs are bound to be high.

In some countries it is not so much lack of main transport arteries that limits the market as lack of secondary, feeder lines and farm-to-market roads. When farmers cannot get their produce to town they cannot take home manufactured goods, nor have they the purchasing power to buy manufactured goods.

Obviously, dependable and low-cost transportation is also needed by manufacturing industries for assembling their materials. Lacking good transportation, a meat packing plant or a cannery will not be able to draw supplies from a large enough area to support an efficient volume of operations. An iron or steel works will find the delivered cost of its coal, ore, scrap, and other ingredients to be excessive.

Manufacturing is often a relatively brief operation performed after a lengthy process of assembling a variety of materials and components, equipment, and fuel. Then the manufactured product has to be distributed to consumers, who may be widely scattered. All this requires transportation. The over-all efficiency of manufacturing in a country may depend as much on transportation outside the plants as on what goes on inside the plants.

A marketing network. Active wholesale and retail trade establishments, and related facilities for warehousing, advertising, servicing, and repairing manufactured products need to develop parallel with factory production. This part of the distributive system is as essential to a flourishing growth of manufactures as transportation itself.

Communications. Without reasonably adequate local and long-distance communications, marketing in the volume needed to sustain modern manufacture is impossible. So is low-cost assembling of materials and efficient management of factory enterprises. Telegraph and telephone systems, postal service, and nowadays broadcasting by radio and television are parts of the underpinning of industrial production and distribution.

Power. Cheap and abundant electric power is essential for some branches of manufacturing, and advantageous to most. A large enterprise may install its own generating equipment, but industrial electricity available as a public utility is important for the encouragement of diversified, small-scale factories.

Water supply. Some manufacturing operations require large quantities of water. The city growth that accompanies industrialization adds to the demand for water. Where the supply is at all scarce or irregular, considerable investment in dams, reservoirs, and aqueducts may be necessary as a part of industrial development.

Housing and urban facilities. As factories multiply and bring more people into cities and towns, considerable public and private investment is required in houses, paved streets, distribution systems for water and electricity, sewage systems, urban transport, police and fire protection, and so on.

Financial services. Banks, insurance firms, securities markets, and related facilities are necessary for handling the money transactions of an industrializing economy and for assembling savings to provide some of the capital for industrial development.

Natural Resources Development

Mineral raw materials. Geological and other explorations to determine more accurately what raw materials are potentially available in a country and where they are located help to lay the foundations for industrial development. It is important to know where to find construction and road-building materials, limestone for cement manufacturing, sands and clays for glass and ceramics, and water for cities, industries, and farm irrigation. If the country is fortunate enough to have important deposits of oil, metal ores, or other minerals in demand on the international market, or if it has climate and soil that give it a profitable export crop, development of these resources may also help to promote industrial development. Income so generated enlarges the market for manufactured goods, and the foreign exchange earnings can help to pay for industrial equipment that must be imported.

Agriculture, forestry, and fisheries. Agriculture represents by far the most important use of natural resources in nonindustrial countries. More efficient utilization of soils and rainfall by

improved cropping practices, irrigation and drainage, better seeds, and proper fertilizers is often the most direct and quickest way to higher real incomes for the bulk of the population. As we have emphasized already, a rise in agricultural income resulting from improved agricultural productivity enlarges the market for manufactured goods and is one of the requisites for sound industrial development. Specialized agricultural developments are also necessary as a foundation for certain processing industries, such as grain milling and canning or freezing of foods. Forestry can provide a raw material basis for pulp and paper making, lumber manufacture and millwork, and furniture making. Fisheries can provide materials for food industries and for fertilizer manufacture.

Human Resource Development

Health. A public health program is a necessary part of industrial development both for the sake of efficient factory work (absenteeism and labor turnover due to sickness are costly, and so is the indolence of malnourished and sickly workers) and for the sake of protecting people against the increased spread of disease that might otherwise result from life in factories and cities.

Education. A modern industrial system and the exchange economy upon which it rests cannot function efficiently where a large fraction of the people do not know how to read, write, and perform simple calculations. A general level of education going far beyond these simple skills is requisite for the most modern types of industrialism. Investment in public education pays handsomely in increased productivity, by laying a basis for individual initiative and by enlarging the reservoir of skilled (or teachable) labor, of managerial and administrative talent, and of leadership in community and business affairs.

Vocational training. Industrial development requires the training of people for skilled jobs both in direct production processes—machinists, mechanics, chemical technicians—and in the work of business offices—accountants, stenographers, salesmen. Training programs within industry and basic vocational training as part of the public system of education are necessary.

The Organizing Factors

Finally, industrial development requires active leadership to provide the intangible but all-important "will to develop" and to organize the new human relationships and the technical production

facilities that together constitute a modern industrial system. Key factors in these tasks of organization are:

Business initiative and management. The scarcity of energetic business organizers willing to undertake pioneer industrial ventures (outside the lines of activity that have become traditional in the country) and the scarcity of modern-trained managers at all levels from foremen to plant superintendents and company directors, are among the most important obstacles to industrial advance in most countries. Broad social changes, such as changes in the social role of land ownership and new definitions of "success," may have to come about if this part of the industrial foundation is to be strengthened. Schools at university level for training in business and industrial management can contribute something, not only by imparting necessary skills but also by helping to make management a profession and raising its prestige.

Trade union leadership. Nowadays trade unions wield great influence in many newly developing countries, practically from the outset of industrial growth. The nature and quality of their leadership can go far toward determining how rapid and substantial that growth may be. Attitudes toward mechanization are crucial. So are basic ideologies, which may lead to a "revolutionary" orientation likely to be disruptive of industrial efficiency, or to a more cooperative approach that aims to advance labor's interest by increasing production, while making sure that a fair share of the increase goes to labor.

Governmental leadership. Programs for development of natural and human resources, many of the utilities and services needed by industry, creation of conditions favoring industrial development, and in some countries actual launching of major industrial projects depend upon government initiative. The quality of public administration and, behind that, the nature of the political forces that give it direction, are bound to have a great influence on the type and rate of industrial growth and on the efficiency and costs of industry.

Applied scientific research. Much of industrial development, for countries only now catching up with modern technology, consists of borrowing techniques from abroad. Borrowed technology usually requires some adaptation to fit the special conditions of the country, however. On-the-spot facilities for applied industrial research can make this adaptation more rapid and effective. Also, special problems encountered by industry in using local materials, in finding

applications for local minerals or crops, in establishing intelligent personnel policies, and in analyzing markets at home or abroad can more readily be solved where public or private programs of industrial research have been established.

This chapter has mentioned the most important general foundations for industrial development. Unless these foundations exist in a country or are being brought into existence, practically any line of manufacturing that is attempted is likely to have such high costs that it may be parasitic rather than productive. In subsequent chapters it will be assumed that reasonably adequate attention is being given to the improvement of these general industrial foundations. Our analysis will henceforth be focused on the specific problem of how to select the lines of manufacturing most suitable for development in the country.

Part II

SELECTING CANDIDATE INDUSTRIES

Chapter IV

THE METHOD OF ANALYSIS

No general prescription can be given which will tell what are the "right" manufacturing industries for a country. Every country is a special case. Its needs and market demands on the one hand, its resources, traditions, and experience on the other, differ in greater or less degree from those of every other country. It follows that the pattern of industry which will be most suitable for it, in the sense that this pattern will do the most to raise the national product, will not be the same as the pattern for any other country.

What can be given is a method of analysis. A procedure will be outlined in this chapter and further developed in subsequent chapters which can be applied to any country, or for that matter to any other area for which a development program needs to be prepared. If carried through systematically, and if good judgment based on reasonably good information is used in making the required appraisals, the method should be a substantial help in uncovering possibilities for industrial development and in selecting those likely to benefit the country most. The concrete answers will differ, and should differ, for each country, and from one stage to another in the development of a particular country.

No method can be devised, of course, which will automatically and invariably lead to the right answers. The best a Manual such as this can do is to direct attention to the right questions. That can be a very important service. It may help to avoid wastes and losses that newly developing countries can ill afford, and it may help them to make faster progress than if these same key questions were to be brought to their attention by sad experience based on trial and error. Naturally, the soundness of the conclusions reached by any method of analysis, including the one recommended in Parts II and III, will depend to a great extent upon estimates and judgments at every step.

"The Area"

The method to be presented is a general one for discovering suitable types of industrial expansion. It can be applied, with appropriate variations which will readily suggest themselves to the reader, to the area development problems of geographic units

both smaller and larger than a country or nation. For example, methods much like those recommended here have been used by local industrial and commercial associations in seeking to determine what kinds of manufacturing they should try to attract to their city or town or metropolitan region. Similar procedures are applicable and have been applied in the work of state or provincial or regional development commissions. They are also appropriate for appraising the industrial development possibilities of a larger-than-national region or economic federation, such as the federation of Central American republics which has been discussed from time to time.

In order to preserve this wide applicability and flexibility in our recommended method of analysis, we shall usually speak of the demands, resources, and other characteristics of "the area." The user of the Manual can interpret that term to mean a country, a metropolitan region, or some other geographic region, depending on the purpose he has in view.

Where the analysis is being made for a national territory of considerable size, sound procedure will often require that many of the steps be carried out separately for various subnational regions. This will be especially true if transportation is difficult and expensive. Thus, if a market estimate were being made in Venezuela for the products of the bakery industry, it would be unrealistic to lump together the demands for baked goods in the Caracas region with the demands in the regions around Maracaibo and around Ciudad Bolívar. Obstacles of both distance and transportation make these distinct economic regions for many purposes. The same principle applies to the analysis of resources. Coal on one side of the Andes, iron on the other, and a market isolated from both by expensive transport do not add up to the conditions for a successful blast furnace operation.

On the other hand, regions that must be treated as largely separate from each other with respect to some commodities, such as perishable raw materials from the farms or very heavy and bulky finished products, may constitute a common market for other kinds of products that are readily transportable. If one is studying market demands and resource availabilities with reference to pasteurizing and bottling fresh milk it may be necessary to analyze separately the area around each major city or along direct, fast transportation lines. But when the prospects for an evaporated or dried milk plant are being studied, the market

area, though not the raw material supply area, can be very much larger. In fact, the possibility of exports may be an important factor to analyze. Some manufactured goods, like building bricks, are practically tied to resources and markets within a few miles. Others, like canned fruits and meats, textile products, and radios, may be sold in distant world markets.

Thus, the size of "the area" to which our discussion applies will depend first of all on the size of the unit whose industrial development probems are under study. But it will also be necessary to give attention to subareas within that unit and to other areas outside it, depending on transportation and marketing conditions and other factors which may affect different commodities differently.

The Recommended Method in Outline

Two major stages, each involving a number of steps, make up the systematic procedure recommended in this Manual for selecting the most suitable manufacturing industries for an area.

The first stage is broadly exploratory. Its purpose is to screen out industries that are obviously unsuitable for the area and to identify others that seem to merit further, more detailed, analysis. The lines of manufacturing that emerge from this preliminary stage will be called "candidate industries."

The second major stage is the more intensive testing of the candidate industries so selected. These industries are weighed against each other on the basis of a number of criteria to be suggested below, and the industries which show greatest promise are selected for practical action.

There are, of course, very important stages of practical action which come after the two stages of the selection process described. Concrete managerial and engineering plans must be made. Arrangements for financing and marketing have to be worked out. Buildings and equipment must be acquired. Personnel must be hired. Then comes the actual launching and operation of the manufacturing enterprise. All this, however, goes beyond the limited scope of the present Manual. Textbooks and treatises on industrial management are available which should be of value to readers who desire further help at this point.(1)

We cannot advise too strongly that anyone undertaking to launch a manufacturing operation with which he has had no previous

experience should not be content with the information about the industry that he can find in the chapters of this Manual or in the supplementary industry profiles. He should get in touch with persons who have had wide experience in that particular line of manufacturing or with professional management or engineering consultants. All that this Manual pretends to do is to provide a systematic procedure and some fairly general information on different industries, so that an intelligent determination can be made that industries A, B, and C seem to offer better prospects for successful and beneficial development in the area concerned, under present conditions, than industries D, E, and F. But a decision to go ahead with industry A should still be regarded as contingent on a favorable outcome of detailed management-planning and production-engineering studies.

Stage I: Selecting Candidate Industries

Three steps are suggested in order to make an intelligent selection, among all possible industries, of those which deserve to be included in the group of candidate industries (see Exhibit IV-1). Step one is an analysis of actual and prospective demands for manufactured goods in the area, and of outside demands which might be filled from factories located in the area. Step two is an analysis of resources useful in manufacturing which are available in the area, or which can be imported at reasonable cost. The resource analysis includes, of course, human as well as material resources. Step three consists in matching, in a preliminary way, the market and resource requirements of each industry on a comprehensive list against the market and resource availabilities of the area.

The rationale of this procedure may be described as follows:

An industry consists of a set of production processes which serves as a bridge between needs or wants, on the one hand, and resources on the other. This is shown diagrammatically in Exhibit IV-2. Each industry uses resources of various kinds as its inputs (raw materials purchased from the owners of farms and mines, labor purchased by payment of salaries and wages, capital purchased by the payment of interest or attracted by a share in profits, etc.) and converts these by an appropriate technology into outputs (shoes, canned goods, steel girders, cement, automobiles, etc.). The goods and services produced by the industry help to satisfy the needs and wants of families, individuals, business firms, and government agencies, while the payments they make for these goods and services constitute the

Exhibit IV-1

STAGE I: SELECTING CANDIDATE INDUSTRIES

Step 1.

Study the area's present and prospective demands for manufactured goods.

a. Demand in the area itself
b. Demand in external markets accessible to it

Step 2.

Study the area's present and prospective resources for manufacturing.

a. Resources in the area itself
b. Resources obtainable by import

Step 3.

Study a comprehensive list of manufacturing industries and select those in which the industry characteristics best match the area's demands and resources.

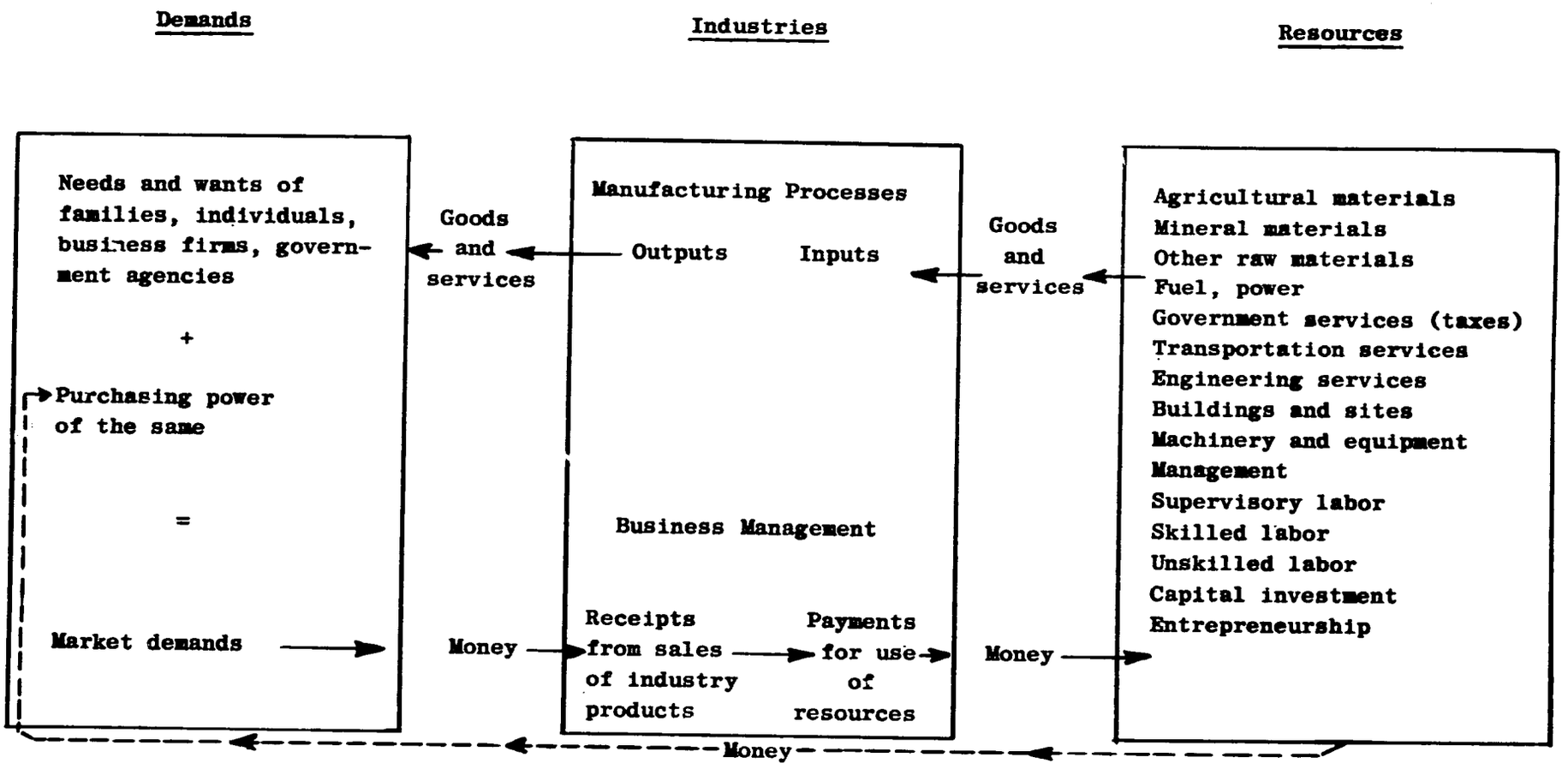
a. Output characteristics should match demands found in Step 1. (Kinds of product; marketing requirements and conditions; scale of operation and therefore size of market required for efficient operation.)

b. Input characteristics should match resources found in Step 2. (Kinds and amounts of materials, machinery and equipment, buildings and utilities, energy, personnel, and supporting services.)

c. Key location factors should point toward advantages in the area. (Orientation toward the market, toward materials in the area, toward kinds of manufacturing costs that are low in the area.)

Exhibit IV-2

THE ROLE OF INDUSTRIES: LINKING DEMANDS AND RESOURCES



industry's receipts from sales. With its receipts from sales the industry can purchase more resources, and the money it pays out for labor, materials, and so on enables the people who supply these resources to turn their needs and wants into "effective demand"—that is, into wants backed by purchasing power.

This process of converting lower-valued resources into higher-valued finished goods creates wealth. The national product is increased. Some of the gain generally goes to the owners of the resources which the industry purchases. They are paid more for their materials, labor, and capital than they could get for these things if the industry did not exist. Another part of the gain may go to the consumers of the product, if the existence of the industry makes it possible for them to get the product in larger quantities or at lower prices. Finally, part of the gain may go as profit to the "entrepreneur" who puts the enterprise together and promotes it.

An industry which takes resources that would otherwise bring a rather low price in the area and converts them into products that are high-priced in the area will not only be operating at a profit in the private sense, but will probably be adding to the real income of the community. (We say "probably" rather than "certainly" because the market price of a product or a resource will not always be a true index of its real economic value to the community. See Chapter VIII.)

This suggests a useful screening device which, though very crude, is quite serviceable as a preliminary method by which to separate the industries that are hopeless for the area and likely to be costly failures if attempted from those that seem to merit serious consideration. For this preliminary appraisal, the most promising industries can be considered to be those which, on the output side, supply products that are strongly demanded in the area (large use, high price), and on the input side draw mainly on resources that are available on favorable terms in the area (large supply, low cost). In addition, the scale of operation at which the industry can produce economically must be considered in relation to the size of the available market, and key locational factors characteristic of the industry must be noted and compared with the situation in the area. This process of matching industry characteristics against area characteristics, summed up in Step 3 of Exhibit IV-1, will be further discussed in Chapter VII.

Stage II: Testing Candidate Industries

The purpose of the second major stage in the analysis is to achieve a comparative rating or ranking of the candidate industries, in terms of the benefit they are likely to bring to the living level of the area. A series of tests will be recommended for application to each industry (or industry group). To apply these tests it will be necessary to restudy more specifically and intensively the demand and resource situation of the area in relation to each candidate industry. Finally, the results of the different tests must be combined in some manner so as to achieve an over-all rating which brings to the top those industries (or industry groups) judged best for the area. These steps are summed up in Exhibit IV-3.

The recommended tests are briefly sketched below. They will be discussed more fully, with suggestions for their practical application, in Part III.

The Test of Net Return

Will the cost of the inputs into the industry be substantially exceeded by the value of the output from the industry? Will this excess be greater or less, in relation to the resources required, than for alternative industries? The rating of an industry on the test of net return may be different depending on whether one is attempting to estimate the contribution it will make to the national product or the profit opportunities of an enterprise in that field. Both should be taken into account. The effect on the national product is the crucial criterion which should guide the policy of national development commissions and other government or community agencies. The return to the enterprise is crucial for the decisions of business firms. One of the main objects of a public development policy which proposes to use the initiative of private enterprise must be to create conditions under which industries that rate high in terms of their contribution to the national product are also attractive from the point of view of private profit.

The Test of Integrated Development

Will the industry be an important part of a larger constellation of developments which, as a whole, will substantially increase the area's economic product? It may be necessary to evaluate a group of interdependent candidate industries (or even a group of industrial and nonindustrial projects) as one unit. For this reason we have added the phrase "or industry groups" from time to time

Exhibit IV-3

STAGE II: TESTING CANDIDATE INDUSTRIES

Step 1.

With reference to the specific market requirements and resource requirements of each candidate industry (or industry group), restudy more intensively the area's demands and resources.

Step 2.

Rate each candidate industry (or industry group) in comparison with the other candidates on the following tests:

a. Prospective net return per unit of resources invested—

(1) In terms of national product.

(2) In terms of private profit.

b. Value in integrated development
c. Stability and growth prospects
d. Balance of payments effects
e. Social desirability
f. The test of experience and competition

Step 3.

Combine the ratings and divide the candidate industries (or industry groups) into three classes:

a. Most promising, appear to merit immediate development. First on the list for action.

b. Next most promising, or likely to be most promising after some other developments have occurred. Defer.

c. Relatively unpromising. Reject, or shelve for reconsideration if and when conditions change.

when speaking of candidate industries. Will the candidate industry directly or indirectly make it easier to establish other worthwhile industries? For example, Industry A may introduce certain skills into the area which help in the subsequent development of Industries B, C, and D. Or it may build up marketing facilities, transportation facilities, sources of supply for materials and services, consumer habits, and specific industrial demands, besides adding to the income and general purchasing power in the area. These results may lower the costs and improve the markets of other industries and thus increase their yields.

The Test of Stability and Growth

Will the industry be more or less subject than other industries to undesirable seasonal swings in demand and employment? Will it perhaps have a seasonal swing opposite to that of some existing activity in the area which it can supplement? How sensitive is it to business booms and depressions? What is its outlook for long-range growth? Is it strongly affected by international political conditions (armament demands, embargoes, tariffs, etc.), or by prospective changes in technology, or by likely changes in the preferences of consumers? Do these factors add up to more favorable or less favorable growth prospects for the industry in the area?

The Test of Balance of Payments Effects

Will the industry bring in net export earnings, or will it produce commodities that would otherwise have to be bought with scarce foreign exchange? Will it require large amounts of imported equipment, materials, or technical services that will have to be paid for in scarce foreign exchange? The importance of these balance of payments effects will depend, of course, on the area's present and prospective ability to earn the foreign exchange it needs in transactions with other areas.

The Test of Social Desirability

Will the industry have desirable or undesirable social and politico-enomic consequences for the local community where it is situated, for the nation as a whole and its regional balance, and for the community of free nations? For example: Does the industry promise to set a desirable standard in such respects as working conditions, health and safety practices, avoidance of water and air pollution, resource conservation measures, and other aspects of

good "industrial citizenship" in its community? Does it lend itself well to a decentralized, dispersed pattern of development in relatively small cities or towns, or will it promote an undesirable degree of concentration in large, already overcrowded cities? Does it promise to encourage a better geographical distribution of industry, as by building up a relatively neglected region? Does it fit into a healthy pattern of international trade development, supplementing rather than merely duplicating on a nationalistic basis industries already being developed in neighboring countries?

The Test of Experience and Competition

Has the candidate industry proved successful and beneficial in other areas where the situation as respects level of income, types of resources, and so on are somewhat comparable to those of the area where it is now being considered? Has it been able to stand up to competition after a reasonable learning period, or does it seem to require indefinite support in the form of protection and subsidies? This test of experience and competition in a sense overlaps the previous tests, but it should help to throw additional light on questions of fundamental importance.

This chapter has presented the framework of a systematic method by which to appraise the industrial possibilities of any area. The recommended procedure should aid in selecting those industries which, in view of the area's particular circumstances, are likely to contribute most to its economic progress. We wish to repeat that after such a selection has been made, and before launching a particular undertaking, a detailed management plan should be made and checked with the assistance of persons who have the necessary practical experience and technical knowledge of the industry in question. The industrial information which can be offered in this Manual is not sufficient for that purpose.

We shall now turn to specific suggestions for making an analysis of demand (Chapter V), of resources (Chapter VI), and of industry characteristics which have to be matched on the one side to demand and on the other side to resources (Chapter VII).

REFERENCES, CHAPTER IV

1. A comprehensive treatment of modern principles and methods used in the management of an industrial enterprise is:

Alford, L. P., and H. Russel Beatty. Principles of Industrial Management. Rev. ed. New York: Ronald Press Company, 1951. Chapter headings include, "Planning: Objectives and Policies," "Organization for Control," "Organization for Operation: Factory Layout and Equipment," "Marketing the Product," "Control of Purchasing," "Quality Control," "Cost Accounting," "Personnel Administration," "Measures of Performance," and others. Selected references are given on all these topics.

Other useful references:

Alford, L. P., and John R. Bangs, eds. Production Handbook. New York: The Ronald Press Company, 1951. Designed as a practical reference book for managers, engineers, and supervisors engaged in manufacturing production. Twenty-five chapters by experts on such topics as "Plant Organization," "Production Planning and Control," "Plant Layout," "Machinery," "Materials Handling," "Job Estimating," "Principles of Management," "Manufacturing Costs," "Factory Budgets," "Plant Personnel."

Goetz, Billy E. Management Planning and Control: A Managerial Approach to Industrial Accounting. New York: McGraw-Hill Book Company, 1949.

Hempel, Edward H., ed. Small Plant Management: A Guide to Practical, Know-How Management. Prepared under the Auspices of the Management Division of the American Society of Mechanical Engineers. New York: McGraw-Hill Book Company, 1950.

Chapter V

ANALYZING DEMANDS

Importance of the Market

The first step in intelligent planning for manufacturing development is to figure out what manufactured products potential customers, in the area or outside, are likely to want and will be able to pay for. This analysis of demand is just as important as the analysis of what resources the area has and how they can be used in manufacturing, but often it receives less than its proper share of attention. That is one reason, though not the only reason, that we are putting it first in this Manual. In the words of two leading students of industrial location trends, "The importance of markets as an attraction for industry has been greatly underemphasized in development programs."(1)

A pioneer in United States industry, Andrew Carnegie, is reputed to have said, "I would rather own a market than a mill." If he could count on enough sales for a product, then it was relatively easy for him to assemble the materials, the equipment, the labor, and the managerial skills to build a factory and make that product. Out of the sales he could pay wages and salaries, buy supplies, pay costs of borrowed capital, and eventually pay for the mill. But if he had a factory all set up and going, without customers who wanted to buy his product and could afford to buy it, then his problem was much more difficult and the whole enterprise might fail.

Sometimes those who are concerned with industrial development and the planners of new industrial enterprises let their attention be so absorbed by the thought of what might be made with particular raw materials, or by production-engineering problems, that they neglect to give equally careful study to the demand for the product and the problems of marketing it. This is true not only in industrially less-developed areas, but even to some extent in industrially advanced countries such as the United States where the crucial importance of "market analysis" is generally recognized. Sometimes elaborate reports have been prepared, often at great expense, in which production flow lines have been carefully laid out and factory costs have been estimated to several decimal places, but the basic assumptions about the demand for the product have been dealt with casually, if at all, by methods likely to be subject to margins of error of a thousand percent.

The close dependence of a factory on the sales of its product is most obvious where the factory is a private enterprise. The revenue from sales is the source of the pay for the workers and the management; if there are not enough customers, or if they do not like the product or cannot afford to buy it, there will soon be no money to keep the enterprise running. The dependence may not be quite so close or so obvious in the case of a government-subsidized or government-operated industry, but still the materials that are used have to be paid for and the workers have to be remunerated somehow. If this cannot be done out of sales revenue (including sales to the government on terms which give the government fair value received) then the enterprise can keep going only if the deficit is made up from funds raised by taxation or otherwise. This means that the product turned out by the factory is less valuable, in terms of the valuations of the market, than the resources used by the factory in making the product. Market valuations do not always accurately reflect "true" value to the community. There are sometimes good reasons for running an enterprise at a deficit, especially at first and in the early stages of an area's development. But it is a good general rule, which will help to avoid misdirected effort and waste of resources, to regard an industry which shows no prospect of earning enough from sale of its product (at competitive prices) to cover its costs (including remuneration to labor and capital at competitive rates) as one that prima facie is subtracting from the community's economic substance more than it is adding.

Market Size and Scale of Operation

The amount of a manufactured product that can be sold is one of the key factors, under modern methods of production, in determining what the product will cost per unit. For the amount that can be sold sets a limit to the scale of operation of the factory, and many manufactured articles can be produced at considerably less cost per unit when production is on a large scale than when it is on a small scale. In order to have low costs per unit of output and therefore to be competitive, a manufacturing enterprise must be able to achieve a certain minimum volume of sales. The phrase "a certain minimum volume" may convey too rigid a notion. What we are talking about is a size-range, which can vary considerably within the same industry depending on local prices of the product and local prices of the resources used, on the choice of alternative processes for manufacture, on the skill of a particular management, and so on.

Some types of manufacturing achieve lowest-cost operation only when the volume of sales permits production on a very large scale. This is why it has not generally been economical in Latin-American countries to produce automobiles and tractors locally. The manufacture of furniture, however, and of canned foodstuffs, many kinds of molded plastics, and numerous other products can be carried on economically at quite a small scale of operation, and sometimes more economically on a small scale than on a large scale. Therefore, a market much too limited in size for low-cost operation of some manufacturing industries may be ample to support others. The growth of these others may eventually enlarge the buying power of the area to a point where the larger-scale types of manufacturing can also find an adequate market.

In this factor of scale of operation we have one of the most important reasons for a careful appraisal of demand before deciding whether or not a particular kind of manufacturing is suitable for an area at its current stage of development.

Buying Power and Growth of Manufactures

It has often been noticed that a large percentage of the capital from economically advanced countries which is invested in less-developed countries serves to produce raw materials for export. Relatively little foreign capital enters such countries to produce manufactures. Sometimes this has been viewed as evidence of a desire to keep the less-developed countries in a state of economic subservience—producers of raw materials only, mere "hewers of wood and drawers of water" for the rich industrial countries. But the real explanation is much simpler. A fairly large market is necessary to induce and justify investment in modern manufacturing industries that have to operate on a large scale to operate efficiently. Where the market is small, many kinds of manufactured goods simply cannot be sold in large enough quantities to support even one modern, mechanized plant at an economical scale of operation.

The size of a market depends on the buying power of the people, which in turn depends on the productivity of the economy. Low productivity and low incomes mean small markets, even where there are millions of people. This is particularly true for manufactured goods, since persons on very small incomes must spend most of their money on food. Also, in parts of Latin America a substantial proportion of the families live from subsistence farming with hardly any cash to spend for manufactures. The size of markets is further decreased by geographical obstacles and lack of

adequate transport and communication, so that in many Latin-American countries the "national market," small even in total, is really a number of still smaller fragments.

All this poses very serious problems for those who are striving to develop modern industry in low-income countries. The small market is without doubt one of the greatest, perhaps even the greatest, obstacle to growth of manufactures in such countries. In other words, there is a vicious circle: Poverty means small markets. Small markets offer little inducement to investment in modern manufacturing. This in turn tends to prevent the growth of productivity and incomes and helps to perpetuate the poverty.(2)

How can industrially less-developed countries break out of this vicious circle? We have already alluded in Chapter II to the role which development of a more productive agriculture can play in enlarging the market and therefore stimulating the growth of manufactures. Also, the income earned by the export of valuable raw materials which the area may be fortunate enough to possess will raise the buying power of the local producers and so help to create a larger internal market for manufactured goods, unless local customs and social conditions keep the income from being widely distributed to people who would use it on such goods. Finally, the growth of those manufacturing industries that can be started, if they are in properly chosen lines and efficiently conducted, raises the productivity and income of the area and thus supplies additional purchasing power which encourages still more manufacturing.

For the growth of manufacturing to be truly efficient and productive, thus helping to turn the vicious circle into an upward spiral, it must be balanced growth. The term balanced growth is often used in a rather vague sense, but its meaning for our purposes can be clearly defined. Those industries in which new investment is made and in which production is increased should be the ones that are needed to meet the new demands that appear as the general income of the community rises. Balanced growth of manufacturing industry means growth in step with the growth of demand and adjusted to it, or perhaps growth just ahead of the growth of demand but correctly anticipating it. The better the existing and prospective demand for various kinds of manufactured goods can be estimated, the better will be the chance of keeping the area's industrial growth in reasonable balance. There will be less waste of scarce resources; fewer "wrong" industries and

more "right" ones will be constructed. This will mean more effective progress toward higher levels of living.

A PROCEDURE FOR ESTIMATING DEMAND

Exhibits V-1 and V-2 present in outline form a recommended procedure for making a systematic analysis of the demand for manufactured goods. They state the basic questions to which answers should be sought in order to determine the significant kinds and amounts of demand for manufactured goods existing in the area itself and to be anticipated some years ahead, and for estimating present and prospective export demands. They cover both consumers' goods and goods used in further production (producers' goods), though, as will be seen below, somewhat different methods and sources of information are applicable to these two sorts of goods. We shall now consider ways of getting answers to the questions posed in the outlines.

First, two general remarks are needed.

1. It would obviously be wasteful, even if possible, to make a detailed analysis of the demand for all types of manufactured goods, many of which the area would obviously be unsuited to manufacture. For the sake of clear exposition we first devote a chapter to the analysis of demand and then one to the analysis of resources, but in practice anyone making such analyses will start his study of demand with at least a general notion of what the area's resources are and will start his study of resources with at least a general notion of the kinds of manufactured products that are in demand. General knowledge and common sense should set certain bounds to the survey of market possibilities and suggest certain points of concentration. However, one purpose of making a very broad survey of the demand for manufactured goods is to turn up ideas for types of manufacturing that may have been overlooked in the past. Therefore, the survey should be genuinely exploratory and not too rigidly directed by preformed conclusions.

2. In Chapter IV a method of analysis consisting of two major stages was outlined by which to choose the industries best suited to an area. Demand-analysis figures in both stages. In the first stage, where the problem is to sift through a comprehensive list of industries with a view to selecting a more limited number for intensive study, we need a wide-sweeping survey to

Exhibit V-1

PROCEDURE FOR ANALYZING INTERNAL DEMAND FOR MANUFACTURED GOODS

Existing Demand

1. Current purchases.

   What manufactured goods are being bought now, in what quantities, at what prices, by whom, for what purposes?

   a. Consumers' goods
   b. Producers' goods

2. Unsatisfied demand.

   What manufactured goods are more or less unobtainable now, or only at a very high delivered price, or not properly marketed, for which there appear to be buyers who would take the goods at a price that might conceivably be met by manufacturing in the area?

3. Marketing facilities.

   What marketing facilities exist for manufactured goods; what are their capabilities and limitations?

4. Competition.

   What is the competitive situation in the marketing of manufactured goods in the area?

Prospective or Potential Demand

1. Goods needed for minimum adequate standard of living.

   What kinds of manufactured goods, in what quantities, would be required in the area if the entire population were to attain some specified "target level" of minimum adequacy in essentials such as food, housing, clothing, medical service, and educational opportunity?

Exhibit V-1 (Contined)

2. Likely future purchases.

What manufactured goods, in what quantities, in what price range, are likely to be marketable in the area five years from now, on reasonable assumptions about the general rate of economic growth? A decade or two from now?

a. Consumers' goods
b. Producers' goods

3. Prospective marketing facilities.

What changes in marketing facilities may be in prospect, or can be brought about?

4. Prospective competition.

What changes in the competitive situation seem to be likely, and can favorable changes be brought about by good merchandising methods?

Exhibit V-2

PROCEDURE FOR ANALYZING EXPORT DEMAND FOR MANUFACTURED GOODS

Existing Demand

1. Present exports.

   What types of manufactured goods are being exported now from the area, if any? To what outside markets, in what quantities, and what prices?

2. Market areas.

   What outside markets are especially close to the area, physically or because of cultural or political ties or cheap transportation or for other reasons? What manufactured goods are now being bought in these markets that might conceivably be produced and exported by the area, or what unsatisfied demands do they have?

3. Marketing facilities.

   What marketing facilities exist for export of various types of manufactured goods from the area, and what are their capabilities and limitations?

4. Competition.

   What is the competitive situation in the outside markets, including established trade channels, customer preferences, or prejudices against the area's products that might be hard to overcome?

5. Political barriers.

   What political barriers exist (tariffs, quotas, exchange regulations, etc.) that hamper or favor exports from the area to the markets in question?

Prospective or Potential Demand

1. Prospective changes in export demand.

Exhibit V-2 (Continued)

What changes may be in prospect in the principal outside markets? Are there any new markets likely to be developing?

2. Prospective changes in marketing facilities.

   What changes in export marketing facilities may be in prospect or can be brought about?

3. Prospective changes in competition.

   What changes in the competitive situation in export markets are in prospect, and can favorable changes be brought about?

4. Prospective changes in political barriers.

   What changes in political barriers affecting the area's exports can be anticipated, and can favorable changes be brought about?

suggest the kinds of manufactured goods that, from the demand point of view, seem to merit further consideration. In the second stage, once the candidate industries have been selected and we desire to test them in detail, a more specific and thorough appraisal of the demand for the products of each candidate industry will be necessary. The methods of demand analysis are basically the same at the two stages, though there must be obvious differences in application between a relatively quick once-over covering a broad front and a relatively concentrated, intensive study of a few products. To avoid repetition, suggestions on ways of estimating demand will be given in this chapter and will not be repeated when we come to discuss the testing of candidate industries.

Tools for Assembling Market Information

The principal tools for obtaining information on the current state of demand for the various kinds of manufactured goods are studies and reports that may already have been made by firms or associations or public agencies (including available statistics), direct observation, and interviews.

The amount of ready-assembled market information in most newly developing countries is likely to be fairly meager. However, there are often commercial publications or banks or trading firms or government departments that have watched economic developments over a period of years and can provide basic information.

The attempt to analyze demands statistically runs into the difficulty in many Latin-American countries that the needed statistics have not been collected. Even in the United States and other industrially advanced countries statistics on consumer incomes and on production and consumption of manufactured products, broken down by types of product and by geographical subdivisions, are fairly recent innovations. Usually, in a country where the economy is at an early stage of development the statistical tools of market analysis are much less available. The situation varies greatly from country to country in Latin America, but often the only considerable amount of already assembled statistical information with sufficient detail and reliability to be useful for our purposes will be in the field of import statistics.

Import statistics may be quite helpful, however, especially in countries where there is not yet much local manufacturing. A large share of the manufactured goods that are consumed must show up as imports. Some Latin-American countries have

detailed import statistics. In others it will be found that the reported classifications are so broad as greatly to limit their utility for market analysis. For example, it is of little use when considering the feasibility of local sulfuric acid manufacture to know only the total import of "chemicals." It may be possible, however, by supplementing the import statistics with direct observations and interviews to estimate what proportion of the chemical imports consist of sulfuric acid.

Direct field work carried out by personal observation and interview, if done in more than a cursory way, is likely to be time-consuming and therefore fairly costly. On the other hand, this may be the only way to get the kind of information that is needed. Oftentimes the direct field observations and interviews need not be elaborate in order to provide much helpful data. Reasonable care should be taken to select a fairly representative sample for whatever is being studied by observation or interview. Textbooks are available to assist those not familiar with the special techniques that have been devised for collecting data of this sort. Some deal particularly with market analysis. The references listed at the end of this chapter will be helpful, though the methods they describe are designed with a highly industrialized economy in mind and may often be too elaborate for application without considerable modification in a newly industrializing country. (3)

A combination of methods, in which statistical and other background facts are supplemented with field observations and interviews, will sometimes yield a surprising amount of information when applied with ingenuity and interpreted with a dash of boldness. This will often permit estimates which, though not very accurate, may serve for the purpose in hand. Even rough estimates may suffice to show that the area's consumption of product X is much too small to justify a local factory, while for product Y the local market is quite good.

The sources of information and the methods which are useful in studying the market demand for manufactured consumers' goods, sold mainly to households (shoes, canned foods, kitchenware, radios), are not quite the same as those which apply to producers' goods, sold mainly to other industries (cement, tin cans, electric motors, steel sheets).

Information Sources: Consumers' Goods

Applicable especially to consumers' goods are these sources:

Consumer income statistics and special statistics. If available, estimates of consumer income or expenditures by income groups and by districts provide a useful base for evaluating other information and for planning observations and interviews. If it is known, for example, that 90 percent of the families in districts outside the capital city and perhaps one or two other urban areas have cash incomes less than $200 a year, then it is clear that the present market for all but the most inexpensive manufactured goods must be in these few urban centers. One recent merchandising survey in Peru estimated that roughly two-thirds of the country's buying power was concentrated in Lima. Some special statistics will throw light on current consumer demand. For example, the number of automobile registrations is a good base from which to estimate the market for replacement tires and batteries and for auto accessories.

Observations and interviews in retail outlets. Items displayed in specialty shops and department stores will show what the public is buying. By estimating the number of retail outlets of various types in a district and then interviewing the managers of a few, selected as representative of each type, a rough idea may be formed about the monthly sales of commodities that seem to merit special analysis.

Observations and interviews in households. We have heard of one instance (it happened to be in the Middle East, but the method might be useful in some districts of some Latin-American countries) in which a local manufacturing firm carried out a very down-to-earth consumer survey. This firm had been engaged before the second World War in making such items as small bridges for canals. During the war it made land mines and acquired metal stamping machinery and other metal working equipment. When the war ended the manager tried to think of new products to which the equipment and work force could be turned. He decided to make a systematic market survey of household needs in the Anglo-Egyptian Sudan. With permission from the government and active help from local religious groups, the firm's representatives went into several villages and selected typical village huts, where they made complete lists of the contents. They noted how often the people purchased various items and what they spent their money for. They also noted the things the householders had made for themselves, such as crude window screens fashioned from rushes, for which a metal screen might be substituted if it could be offered cheaply enough. They even listed the contents of peddlers' carts, as another index of what people were buying.

As a result of this market survey, the factory turned to making pots and pans (which were marketed successfully after some trouble in convincing people to accept aluminum instead of the more expensive copper and brass which were traditional). It also produced rings, bracelets, and other items.

More complicated and sophisticated techniques than those in the foregoing example have been devised for consumer surveys in areas where the income level is higher and possessions more numerous. The use of interviews and questionnaires to study the wants and buying habits of carefully selected cross-sections of the buying public has become a highly developed art in the last few decades, especially in the United States. Some of the procedures are described in works mentioned at the end of this chapter. (3) But none of these sophisticated techniques demonstrates as directly as the example just given the basic principles of consumer market research: find out what people use, what they need and want, what they are willing to spend their money for, what they can afford.

Information Sources: Producers' Goods

Especially applicable to the analysis of the demand for producers' goods are these sources:

Production statistics. If information is available on the number of houses, buildings, and bridges being constructed annually and on plans for new highways, this will give a clue to the demand for cement. Similarly, the rate of development of agricultural production and the opening up of new agricultural land may provide some basis for estimating the demand for agricultural tools, fertilizers, and insecticides. Sometimes the purchases of such goods by producers in a few districts, if this is known or can be ascertained, will enable estimates to be made for other districts. Information from other countries may even be used as a basis for estimates if conditions are not too dissimilar.

Interviews with large purchasers. Construction firms, architects, military supply officers, local manufacturers, and others may be in a position to give reliable information on large fractions of the current use of certain products.

Information Sources: Both Types of Goods

Applicable both to consumers' goods and producers' goods are these sources:

Import statistics. Because import statistics of some sort are available in every country and because countries in the early stages of industrial development import most of their manufactured goods, this source of information is probably more often used than any other in analyzing the demands for manufactured goods in newly developing countries. For example, when Mexican authorities some years ago were considering steps to establish a chemical industry in that country, they engaged a well-known chemical firm to advise them. One of its first steps was to attempt to estimate the current use of chemicals in Mexico, and for this purpose the main reliance was on import statistics. As mentioned earlier, the utility of import figures for this purpose depends very much on the detail in which manufactured products are classified for import reporting purposes.

Trade publications. In some of the Latin-American countries where the economy is relatively far advanced, business journalism has developed to a point which makes it an important source of market information. General commercial and financial reviews and any specialized trade publications that exist should be examined.

Interviews with persons concerned with production, trade, and finance. Much firsthand information can usually be obtained from importers, wholesalers, bankers, manufacturers in the area, representatives of outside manufacturers who sell in the area, transportation people, government officers engaged in promoting or regulating economic activities or in assembling census and customs statistics, trade association staffs, trade publication staffs, and staffs of business services.

Special Topics of Inquiry

In addition to gathering information and making estimates on the amounts of various manufactured goods being bought and consumed, it is important to try to determine what kinds of people or establishments are doing the buying, for what purposes the goods are being used, and other facts that may throw light on the probable future trend of the demand. Information on current prices and price trends should be collected.

The investigator should be alert for indications of unsatisfied demands. Does it appear that householders or business firms or government agencies would like to buy certain kinds of manufactured goods that are not now obtainable in the area, or obtainable only at a very high delivered price? Are there manufactured

goods which seem to be purchased eagerly where they are known, but are not now being offered in all districts, or are not being actively enough displayed or advertised? Is the sale of some kinds of goods unnecessarily handicapped by uneven quality or very high profit margins? The answers to these questions will emerge from some of the observations and interviews suggested. In addition, it might be revealing to compare sales of specific manufactured goods with similar sales in other areas not too different in culture and income. Outstanding differences might point to latent demand which could be brought to life by better merchandising, perhaps in connection with local manufacture.

It is important also to study the marketing facilities for manufactured products in the area, noting their capabilities and limitations. Obviously, there can be active demand for frozen foods only in places where distributors and retailers have refrigerated storage and refrigerated sales counters; while widespread use of refrigerators in households is necessary before there will be much effective demand for frozen fruit juices. Technical engineering services are important in connection with the sales of some manufactured goods. Others need a dealer organization able to handle maintenance and repair work. Somewhat less obvious, but even more pervasive and important in its effects on prospects for manufacturing industry, is the difference between modern merchandising methods and what we may call the traditional pattern. Modern manufacturing, with its requirement for large, steady output to achieve low-cost production, depends on broad distribution and rapid turnover in the sales of its products. The way in which new ideas in distribution may stimulate local manufacture is well illustrated in a recent study entitled, Sears, Roebuck de Mexico, S. A. (4)

Finally, the competitive situation for various kinds of manufactured goods must be considered. This requires looking into competition or potential competition both from local manufacturers and from imports. An attempt must be made to find some basis for estimating what proportion of the existing or prospective market a new local manufacturer might reasonably hope to win. Would the distribution channels be tied up in one way or another by competitors? What pricing policies are being followed now, and what might the price situation be if new production were started in the area? Perhaps the previous experience of local manufacturers in other lines might throw light on these questions, or experience in other areas with similar conditions might be drawn upon.

Estimating Future Demands

In starting new manufacturing industries or expanding present ones it is really the demand of tomorrow, not the demand of today, that needs to be known. Many industries use highly specialized equipment which lasts for quite a long time. Also, if the area is to derive the greatest possible benefit from the special efforts which managers must put into acquiring experience in the industry and which workers and the community have to make in the process of building a trained labor force, obviously, industries chosen for development should be those for which there is a prospect of long-continued demand and, preferably, for substantial growth.

The launching or expansion of an industry is an act of faith in the future. If all such decisions were based wholly on today's power to buy and on the size of the markets as determined by that buying power, hardly any new industries would be started. This is particularly true in less-developed countries where the "vicious circle of poverty" described earlier is an important factor. Each new industry has to be based to a considerable extent on the faith that other industries (also agriculture, commerce, etc.) will be expanding their production at the same time. The increased productivity and the incomes generated by all the industries together will enlarge the market and justify the act of faith. But for this process of economic growth and industrial expansion to work well, there must be balanced development in the sense explained earlier. That is, the industries which expand must be those for which demand expands as the economy grows. Both the community at large and the private owners and workers who participate in industrial expansion have a great stake in correct anticipation of future demand.

One way to look ahead in a newly developing area is to think in terms of the physical needs of the people for food, clothing, housing, health services, and educational opportunities. This, of course, like all methods of forecasting that depend on per capita figures, also involves making an estimate of future population. In many Latin-American countries the number of people is growing rapidly—as much as 3 percent a year in some cases. Taking as a "target" some standard of minimum adequacy in food, clothing, housing materials, hospital equipment and medical services, school equipment and educational services, and so on, it is fairly easy to calculate the needed increase in some of the outstanding consumers' goods.

The chief value in such an exercise is that it focuses attention on the ultimate purpose of economic development, which is to increase the power of the people to enjoy those goods that they need and want. It also calls attention to the fact that the small size of the market in less-developed areas is mainly due to low productivity and low income, which makes it impossible for the people to satisfy their needs and wants. As a practical guide for deciding what industries to set up next, however, it does not get us very far. We must try to estimate how rapidly the long-range needs and wants of the people for various types of commodities can be translated into effective, market demand, that is, into wants backed by real purchasing power, which in turn depends on productivity. We also need to know how the market for producers' goods as well as consumers' goods will grow.

There are four principal ways of estimating the future market for manufactured goods in general and for specific products. A fifth is under development but is not likely to be applicable for some years. All, of course, are subject to the inevitable errors in any attempt to guess the future. Where one method is inapplicable for lack of data or other reasons another may be feasible. Also, to some extent one method can be a check on another. The five ways are:

Projection of the trend in purchases of manufactured product. If imports plus local production of paper, for example, have increased 25 percent in the past decade, and examination of the uses of paper in the area and interviews with knowledgeable persons reveal no reason to expect this trend to change suddenly, then it may be reasonable to estimate about a 12-1/2 percent increase in the use of paper over the next five years. The same can be done for other important manufactured products. Of course, a simple projection of trend will not be justified if there have been unusual influences at work in the recent past, or if there is a definite expectation (more than a meager hope) that the area is about to enter upon a period of extremely rapid development, or if new factors affecting this commodity are appearing on the horizon. Perhaps appropriate allowances for the disturbing factors can be estimated in some manner. It may be that inspection of trends in other areas where conditions respecting this product are similar, or have been similar, will be helpful.

Projection of a relation between purchases of a manufactured product and especially pertinent data of other sorts. A study of "Factors Influencing Iron and Steel Consumption in Latin America" issued by the Economic Commission for Latin America explored

the relationship between the amount of iron and steel used in various Latin-American countries and such factors as building activity, population and population growth, manufacturing activity, cement consumption, and national income per capita.(5) Where such relationships can be established either from experience in the area concerned or from that of other not too dissimilar areas, knowledge of expected future developments in some of the related factors may throw light on the prospective demand for the manufactured product under study. Where there are definite plans extending several years ahead for irrigation, highway construction, port building, enlargement of the school system, increase of electric power facilities, transportation improvement, and so on the market outlook for a number of manufactured goods may be estimated in part by relation to these projects.

Projection of the relation between purchases of a manufactured product and the community income. Experience in many countries has shown that there is a quite close relationship between purchases of many manufactured products and such measures of the community's over-all economic progress as national income or gross national product or consumers' disposable income. Some of these measures are already available in a number of Latin-American countries, and their use is spreading rapidly. After a few more years in which to accumulate experience it should be possible to obtain fairly revealing correlations between national income and the market for various kinds of manufactured products in different countries with similar cultural backgrounds and needs.

To use such experience in projecting ahead, for the purpose of estimating the future demand in an area for various types of manufactured goods, one has to assume an over-all growth rate for the area's economy. The assumed rate of growth may be based on past experience in the area itself. Or it may be based on a target rate which seems reasonable in view of attainments in other areas with similar situations and in view of definitely planned measures to stimulate economic growth.

Having assumed a rate of growth and having projected the national income some years ahead, it would be convenient if one could simply assume that a given percentage rise in total income would bring the same percentage rise in sales of shoes, canned foods, cement, bottled beverages, and electric fans. But the matter is not that simple. When a community doubles its real income (an average growth rate of 3 percent a year, compounded, means doubling income in about twenty-five years) its per capita purchases of staple foodstuffs are not likely to double.

Per capita purchases of certain processed foodstuffs, including many kinds of canned goods, may more than double, however. Similarly, there will be considerable variations in the extent to which the community spends its increased income on phonograph records, paper, furniture, automobiles, jewelry, soap, and other things. The demand for some goods will rise by a greater percentage than the rise in total income, the demand for others by a smaller percentage. The technical term for a measure of the degree to which the demand for a particular product is affected by changes in total income available is "income elasticity of demand."

It is feasible, by studying the past behavior of the demand for various manufactured products in the area, and in other areas, as total income has changed (making allowance, so far as possible, for other factors such as changes in relative prices) to estimate how particular products may be affected by income growth. Such estimates, applied to the projected over-all growth in the area's income, may give a more likely forecast of what will happen to the market demand for specified types of products as a result of economic progress than can be had without such analysis.

Projection of consumer expeditures for various manufactured products to an assumed new income pattern. From family budget studies in the area or in other areas not too dissimilar, information can sometimes be had on the expenditures of an average family (or a "consumer unit," which is a more accurate statistical device) at certain specified income levels. Suppose suitable studies applying to the area concerned have been made for families with incomes of $100 a year, $200, $500, $1,000, and so on. An estimate must also be made of the number of families at these various income levels today, and of how this pattern of income distribution might be changed in the next five years or in the next decade or two by the expected economic progress of the area. Perhaps it can be assumed that during the period in question a substantial percentage of subsistence farmers who have had hardly any cash income will be brought into the market economy by a program of road building and agricultural improvement, so that they will figure at the $200 expenditure level. Again, it might be assumed that the general rise in productivity and income would raise most of the families now on the $200 level to an average $300 level, and that there would be corresponding rises in income status all along the line. The effect of these assumed changes on the demand for various classes of products can then be calculated. This method applies, of course, only to consumers' goods.

Projection of interindustry (input-output) relations. A new tool which may prove very useful in forecasting the demand for producers' goods, as well as in other problems, is still in the developmental stage. This is the detailed analysis of interindustry relations by means of "input-output" tables. This device shows for the textile industry, for example, how much of its output goes to each of all the other industries (tire making, clothing manufacture, etc.) and to households. It also shows how much the textile industry buys from each other industry (from agriculture, from the chemical industry, etc.) and how much it pays out to households in wages and salaries. Once such a table has been assembled, calculations may be made from which the effects on every industry of a given change in any particular type of demand may be estimated. Thus, if there is an assumed increase in housing construction, the likely increase in purchases from the lumber industry, the paint industry, the cement industry, and other industries directly affected may be calculated, and not only this, but also the indirect effects on other industries from the expanded operations of the industries first affected. An indirect result, for example, may be increased sales of machinery and motor trucks for logging operations, and this in turn will have other repercussions on industrial demand. The new method makes it possible to get a quantitative idea of the likely total effects, direct and indirect.

The assembling of an input-output table for a country with a complex economy like that of the United States, with enough industrial subdivisions and sufficient recognition of dynamic changes to make it practically useful in market analysis, is a very large undertaking. Then there is the task of calculating, which involves solving a large number of very long simultaneous equations. In fact, the technique has really become feasible for practical purposes only since the development of electronic computers. In industrially less-developed countries, the simpler structure of the economies reduces the requirements for data (as compared with those needed in the United States and other large countries) and reduces the calculations. But the inadequacies of the data available are serious handicaps. Some experiments are already under way with the new technique in Latin-American countries. Perhaps in a few years it will begin to be helpful in connection with their problems of planning for industrial expansion.

References

The Economic Commission for Latin America of the United Nations has issued a "Preliminary Study of the Techniques of

Programming Economic Development," in which some of the methods of estimating future demand mentioned above are discussed and illustrated.(6) The staff of ECLA has found that statistical data for use in studying the behavior of demand for manufactured goods in Latin America are quite limited at the present time. No doubt this situation will improve gradually as the importance of demand analysis in rational development planning receives more recognition.

A document on "Techniques of Material Resources Budgeting" issued by the Economic Commission for Asia and the Far East discusses various methods of projecting demand and also contains a good introduction to input-output tables and their possible future application in estimating requirements for producers' goods and primary resources in newly developing countries.(7)

A number of textbooks and other published materials which will be helpful in connection with the demand-estimating problems discussed above are listed in the notes at the end of this chapter.(3)

Existing and Prospective Export Demand

So far we have considered only an area's internal market for manufactured products. In Latin-American countries the internal market will undoubtedly continue to be by far the most important for most kinds of manufactures. In the home market the advantage of nearness and the effects of political measures which favor local industries give important cost and price advantages. Thus, many types of manufacturing may be able to supply some or all of the domestic market, even though they cannot, at this stage, compete successfully in the world market.

There are some manufactured specialties, nevertheless, which certain Latin-American countries export successfully to other countries in the region, or to markets in North America or Europe or elsewhere—for example, processed meat products, rayon, paper. The possibility of manufacturing for export may exist because one or more key resources are low in cost in the area, because of efficient management, because of favorable location in relation to some outside market, or for other reasons.

All such possibilities are well worth exploring. Not only do export sales help to build output and thus to gain some of the economies that come from a larger scale of operation, but they have a special value for countries with a chronic scarcity of foreign

exchange. This point will be further discussed in Chapter XI, which deals with the balance of payments effects of expansion in various industries. Also, for areas largely dependent for their earnings of outside purchasing power on one or a few major raw material exports, which is the case with quite a number of Latin-American countries, there are sound reasons for carefully exploring every possibility for diversification of exports.

All these considerations make it worthwhile to examine export possibilities for manufactured goods that can be made advantageously in the area. These possibilities will be found, if at all, among the industries for which the resource situation in the area is particularly favorable. If such possibilities appear, then a further analysis of the present and prospective demand for the products in question should be made with respect to each outside area to which substantial export sales might be feasible. A suggested procedure for analyzing export demand is outlined in Exhibit V-2, earlier in this chapter. Pertinent questions are indicated to which answers should be sought, and the outline is self-explanatory.

If a particular outside market seems to offer a very important outlet for the area's potential manufactures, then the time and expense of an on-the-spot study may be justified. In such a study the ways of gathering information and making estimates are very similar to those already discussed in connection with internal demand. For a preliminary survey, and for the less important export possibilities, published sources of information, supplemented so far as possible by special reports and by interviews with export merchants and others who have information, will have to suffice.

REFERENCES, CHAPTER V

1. McLaughlin, Glenn E., and Stefan Robock. Why Industry Moves South. A Study of Factors Influencing the Recent Location of Manufacturing Plants in the South. Washington: National Planning Association, Committee of the South, Report No. 3, June 1949. Page 118.

2. Nurkse, Ragnar. Problems of Capital Formation in Underdeveloped Countries. Chapter 1, "The Size of the Market and the Inducement to Invest." Oxford: Basil Blackwell, 1953.

3. The following books contain detailed expositions of modern methods of market analysis:

   Brown, Lyndon O. Marketing and Distribution Research. New York: Ronald Press Company, 1949. Covers the whole range of research on marketing and distribution, including practical field methods, planning the sample, tabulating, and interpreting results.

   Bradford, Ernest S. Marketing Research: How to Analyze Products, Markets, and Methods of Distribution. New York: McGraw-Hill Book Company, 1951. A textbook for college students, not exhaustive, but designed to be simple and clear.

   Lorie, James H., and Harry V. Roberts. Basic Methods of Marketing Research. New York: McGraw-Hill Book Company, 1951. Emphasizes scientific method in marketing research. Especially strong on sampling theory and problems.

   The following work deals with survey methods in many types of social research and gives practical step-by-step procedures, from the design of the sample down to the color of the paper for a printed schedule and the mechanics of writing a report:

   Parten, Mildred. Surveys, Polls, and Samples: Practical Procedures. New York: Harper & Brothers, 1950. Includes a bibliography of more than a thousand titles.

   Methods of estimating future growth of production, income, and expenditures on various classes of goods are discussed (with particular reference to the United States, but the principles are general) in an appendix to:

Dewhurst, J. Frederic and Associates. America's Needs and Resources: A Twentieth Century Fund Survey which Includes Estimates for 1950 and 1960. Appendix 9, "Methods Used to Estimate Industrial Production, and Probable Expenditures for Consumption Goods and Services and for Capital Goods, in 1950 and 1960." New York: Twentieth Century Fund, 1947.

4. Wood, Richardson, and Virginia Keyser. Sears, Roebuck de Mexico, S. A. Washington: National Planning Association, 1953.

5. United Nations, Economic and Social Council, Economic Commission for Latin America. Study on Iron and Steel Industry and Report on Meeting of Experts Held in Bogota and Sponsored by the Economic Commission for Latin America and Technical Assistance Administration. E/CN. 12/293. February 1953. Volume II, Addendum 1, on "Factors Influencing Iron and Steel Consumption in Latin America."

6. United Nations, Economic and Social Council, Economic Commission for Latin America. Preliminary Study of the Technique of Programming Economic Development. E/CN. 12/292. 15 March 1953. See especially: Part One, Chapter I, Section 5; Chapter IV, Section 1; Part Two, Chapter IV, Sections 1, 2, and 3.

7. United Nations, Economic and Social Council, Economic Commission for Asia and the Far East. Techniques of Material Resources Budgeting. E/CN. 11/I&T/97. 21 December 1953. See Chapters IV and V.

Chapter VI

ANALYZING RESOURCES

A resource is truly a resource in the economic sense only if it can help to produce something which somebody wants at a cost that he is willing to pay. In analyzing the resources of an area from the point of view of the area's suitability for various kinds of manufacturing we cannot count among today's resources timber located in the middle of the jungle or minerals so far underground or so far from transportation that the labor of getting them out costs more than the materials are worth. The cost factor is all important in appraising the industrial usefulness of an area's resources.

Resources are partly fixed by nature in patterns unchangeable by man. Thus, some areas have petroleum and others do not; some have warm humid climates and others do not; some are capable of growing special fruits and vegetables, while others are much better adapted to forestry, and others to particular types of mineral extraction. However, petroleum can be transported (at a cost), conditions of heat and humidity can be controlled in modern factories (at a cost), and in one way or another many other resource advantages or disadvantages can be offset—generally at a cost. Natural resources may confer a cost advantage on a particular area with respect to particular kinds of manufacturing, but this advantage may be ineffective because of lack of other kinds of resources that are also essential, or because of distance from the market, lack of marketing facilities, poor organization, or unenterprising business leadership.

Many of the important manufacturing resources are not fixed by nature. They can be increased or modified by man. This is obviously true of the supply of capital and of trained manpower. Even the supply of minerals, though in some ultimate sense it is fixed by nature, is in practice modifiable by man through more thorough geological surveys, better methods of prospecting and mining, and new roads. Therefore, as in the analysis of demand, we must analyze resources in terms of the existing situation and also in terms of the situation as it may become or may be made to become.

Not all resources needed in a particular line of manufacturing have to come from the area where the manufacturing is carried on.

In fact, successful manufacturing areas rarely have a complete supply of the resources they use. Many raw materials are readily movable and can be imported at fairly small cost. Notable industrial complexes exist which use largely imported materials. Examples are England, Belgium, Japan, and the New England area in the United States.

An especially important type of resource which can often be imported to advantage in the early stages of developing a manufacturing industry is partly manufactured goods and component parts. There may be a considerable saving in cost by performing the assembly operations close to the market, even though the parts are made elsewhere. Beginning at this end, the manufacturing process may eventually be extended back toward the earlier stages.

Another rather frequent resource import in the early stages of manufacturing development is specialized technical personnel or managerial personnel, attracted from other areas as immigrants, hired under contract, or brought into the area in connection with private foreign investments. This may make possible the productive use of a large array of other resources which would lie unused without such imports of specialized manpower. The necessity for importation will be only temporary if proper steps are taken for the training of local people.

Conversely, the existence of certain very evident resources, especially raw materials, within an area does not necessarily mean that manufacturing based on these resources will be economical and beneficial in the area. Other resources not quite as evident may be even more important than this raw material in determining the total cost of resources that go into the manufactured product—for example, technical labor, supervision, and capital equipment. The total cost of all the input items is the important thing on the resource side. Also, factors on the marketing side may pull manufacturing to a location quite far from the origin of the most conspicuous material. The midwestern states of Colorado and Wyoming in the United States are wool-producing areas. From time to time people in the region have said, "Why should we ship our raw wool all the way to the eastern United States for processing into yarn and cloth and then buy back the finished product, paying transportation both ways? Why not process wool here?" Sometimes reasoning of this type turns out to be valid, especially if the raw material is difficult to transport and if there is a substantial weight loss in the process

of manufacture. But a "single factor argument" of this sort may leave out very important additional factors. Thus far it has proved to be less costly to ship Colorado and Wyoming wool to the eastern United States for processing in a specialized industry, shipping part of the product back, than to do the processing in the wool-growing area.

Procedure for Analyzing Resources

At this step in the analysis of an area's industrial potential it is necessary to make a systematic inventory of all types of resources in the area that might be usable in manufacturing. The purpose is to determine the presence or absence of specific kinds of resources required in different lines of manufacturing and to ascertain their location, quality, abundance, and probable cost. This information, when fitted together with information about the resource requirements of different industries and about the market demand for the products of these industries, will enable an intelligent preliminary choice to be made of industries most suitable for development in the area.

An outline for such an inventory is offered in Exhibit VI-1, while Exhibit VI-2 suggests key questions to which answers should be sought with respect to each variety of resource in the inventory.

Obviously, this analysis of resources can be conducted with almost any desired degree of comprehensiveness in detail. It can be merely a quick survey for general orientation, based on information already assembled and published or readily obtainable in interviews with a few knowledgeable people. At the other extreme, it can be a work of monumental proportions based on original field surveys and comprising accurate, scientific investigations of each aspect of the area's resource picture. At what level between these two extremes the resource analysis should be pitched depends on the purpose for which the exploration of industrial opportunities is being made, the importance attached to it, the previous work that has been done to catalog the area's resources, and the time, expense, and trained personnel available for new work of this kind.

Human Resources

Industrial resources are not solely material. In fact, if any one set of resources can be singled out as the key to successful development of manufacturing, that set would surely be an area's human and social resources—labor, management, and organization. Why has Switzerland developed into one of the most prosperous and diversified of industrial countries? Why has Japan far outdistanced other countries

of its region in modern manufacturing? In neither case can a good explanation be based on natural resource factors. In fact, an observer who examines these two areas with his mind set on a common preconception that industrial resources are largely geophysical (especially if his thinking is colored by the notion that industries must be built around a "coal-iron complex") would have to conclude that both Switzerland and Japan are strikingly deficient in industrial resources. Yet both are industiral leaders.

This ceases to be a paradox when we recognize that it is the human resources which shape and control the material resources in industrial development. Ways can be found to overcome many material deficiences if the human talents are highly developed, and if the environment of social, political, and economic institutions is favorable. But if the human skills and institutions which make for effective industrial production are not available in an area, then no amount of material resources will bring a successful industrialization. This is why we have reversed the usual procedure and have given human resources first place in the inventory, ahead of natural resources, industrial facilities, and capital.

One important step in analyzing human resources is to study the supply of labor, noting especially the different skills and grades that are available, the rates of pay that are considered normal, and the general level of industriousness and productivity that may be expected. What special skills are already widespread? Sometimes these are transferable to new lines of manufacturing. Are there aptitudes and preferences for particular kinds of factory work? For example, one element which has encouraged electronics manufacturers to set up plants in Puerto Rico is the remarkable dexterity of Puerto Rican women workers in assembling small parts—said to far exceed that of workers in the United States. What educational preparation do the people have as the basis for acquiring new industrial skills? What vocational training programs are in operation? Some kinds of manufacturing—for example, most chemical industries—require a relatively large percentage of technically trained labor and supervision. What of the availability, quality, and cost of the services of trained chemists, electrical engineers, and so on in the area? Must those types of manufacturing which demand much of this kind of help be postponed until educational and training facilities can be improved, or does experience show that competent outside personnel can be attracted to the area to perform such jobs without running costs up prohibitively? Again, some kinds of manufacturing require a larger proportion of skilled, experienced plant supervisors and foremen in relation to the total number of workers employed than do others. Important skills

Exhibit VI-1

OUTLINE FOR AN INVENTORY OF MANUFACTURING RESOURCES

Human Resources

1. Labor.

    a. Unskilled
    b. Skilled.
    c. Technical
    d. Supervisory

2. Management.

    a. Entrepreneurship
    b. Managerial personnel

3. Organization.

    a. Business institutions and traditions
    b. Education, training, and research
    c. Stability and order

Materials and Power

1. Agricultural, forestry, and fisheries products.

    a. Foodstuffs
    b. Fibers
    c. Fuels
    d. Materials used in chemical manufacture

2. Minerals.

    a. Metals
    b. Fuels
    c. Construction materials
    d. Materials used in chemical manufacture
    e. Water

3. Power.

4. Partly manufactured products and component parts.

Exhibit VI-1 (Continued)

Facilities and Equipment

1. Industrial facilities.
2. Machinery and other equipment.

Capital for Investment in Manufacturing.

1. Available in specific lines, including reinvestment of earnings.
2. Available more generally.

Exhibit V1-2

KEY QUESTIONS FOR ANALYZING AN AREA'S MANUFACTURING RESOURCES

Obtain answers to these questions for each variety of resource noted in the inventory, including specific subvarieties where important:

1. Is this resource present in the area in significant amounts? If so, what is its location, ease of accessibility? Approximate cost, delivered to a possible factory site?

2. Comparing this resource with similar resources in other areas, is it relatively abundant or relatively scarce in the area under study? Relatively costly or relatively cheap? In other words, is this resource to be considered a strong point or a weak point in the area's manufacturing capability?

3. Having answered the preceding questions on the basis of the present supply of this resource, what of the prospective supply? Does the area have a promising potential for this resource or not? What effective steps can be taken to increase the supply and decrease the cost of the resource? Is it likely that such steps will be taken and will bring results within the next few years?

4. Can a deficiency in this resource be overcome, temporarily or permanently, by importing the resource at low enough cost to make its use in manufacturing economically feasible?

are represented by maintenance engineers, designers, and personnel managers. Is the area strong or weak in such types of industrial personnel, and what are the prospects for augmenting the supply of such personnel?

An area's resources in management personnel will be one of the prime factors in determining not only the general success or failure of efforts to develop manufacturing but also the kinds of manufacturing which the area is best suited to undertake. Some kinds, particularly those requiring large capital investments and a comparatively large scale of operations, are likely to need complex and specialized types of management skill. An area lacking in experienced personnel of this kind would be well advised to work up gradually to such types of manufacturing.

The outline in Exhibit VI-1 lists "entrepreneurship" as one of the human resources. This is a willingness and capability to embark on industrial ventures, to be enterprising, to undertake new things, and to carry the risk of success or failure. It is a human resource which occurs much more abundantly in some societies and in some epochs than in others, for reasons which are only dimly understood. If the social, political, and economic institutions of an area are such as to produce an abundance of this key resource, then that area will be able to undertake many kinds of ventures with success. If not its industrial efforts will have to be limited largely to routine and traditional activities.

Entrepreneurship involves a vital spark which may or may not be implanted by business training. However, it is possible to train management personnel so that they can perform their important tasks more effectively. Increasing the supply of well-trained managers will help to make more effective whatever vital sparks of entrepreneurship do appear. An inventory of human resources should therefore take account of the existing supply and the potential sources of competent managers of industry. Are many being trained on the job in present industries? Is the educational system preparing enough young people for managerial responsibilities? The opportunities for secondary and university education and the types of education which they offer are important factors here. It appears that only a few Latin-American countries have advanced training facilities in modern methods of business administration (excepting the traditional work in accountancy and law), and until this is remedied it will tend to limit the scope of their manufacturing activities.

We have mentioned ways in which the business institutions and traditions of an area and its facilities for education and training affect its manufacturing prospects. A word should be said about research. There are more and more "research-based industries" these days. Applied industrial research and the research department as an integral part of a manufacturing concern are relatively new ideas which are already exerting a considerable influence on the course of industrial evolution in the United States and other industrially advanced countries. It is possible to set up and operate successfully an industry which is based on the results of research without repeating the pioneer research that gave it birth. For example, the manufacture of many synthetic fibers, plastics, and electronics products can be carried on by methods already standardized. But in more and more lines it is hardly possible to keep up to date and to meet competition (both in types of product and in costs of manufacture) unless the industry has a research department or can turn to research institutions in the area to solve problems and produce new ideas. The existence of industrial research personnel and of research establishments is therefore a point to be assessed in the inventory of human resources. On it may depend the advisability of entering some lines of manufacturing that are evolving rapidly in close connection with scientific progress.

Finally, the degree to which an area can provide stability and order and a congenial political and social climate for industrial growth will affect decisions on the kinds of manufacturing that it ought to undertake. A lack of stability and order tends to limit the industrial possibilities to those lines in which a relatively small investment is required and in which the capital can be quickly recovered. In other words, such conditions tend to induce quick, semispeculative, profit-seeking rather than steady, sound, industrial upbuilding. Manufacturing that requires complex organization, heavy investment, and a continuous flow of production over a comparatively long period of time (and this is characteristic of much modern manufacturing) is not suitable for a situation that is full of uncertainties.

Materials and Power

The materials requirements of modern manufacturing industries are often highly specific and exacting. Not just "coal," but coal meeting certain specifications as to physical characteristics and presence or absence of other substances is needed for particular uses, such as the making of coke to be used in blast furnaces. For other uses a very different type of coal may be required, or

at least may be much cheaper to use. Not all varieties of the same fruit are suitable for canning, as the industry profile on the canning industry in Appendix B points out. It is generally said that "limestone" is one of the important ingredients in manufacturing cement. But in one country where there was plenty of limestone it looked for a time as though large quantities of cement were going to have to be imported and even transported inland at great expense to build some large public works because tests showed that cement made locally would not harden properly on account of phosphates contained in the limestone. The problem was finally solved by technical research which discovered a way to counteract the harmful effect of the phosphates, and also, as an alternative, a way to remove the phosphates economically and turn them into fertilizer. The incident illustrates, nevertheless, how important it can be to appraise materials for potential industrial use very carefully before counting them as true industrial resources.

We cannot, of course, describe the industrial uses and specifications of each of the hundreds of industrial materials. But we can suggest sources of information to which users of this Manual can turn for detailed help on materials which may offer industrial opportunities in their area. See the references listed at the end of this chapter.[1]

The products of an area's agriculture, forestry, and fisheries often provide a sound basis for local manafacturing, especially where the unmanufactured material is perishable, or heavier or bulkier than the manufactured item, and therefore more costly to transport. The resources inventory should include an assessment of all the promising materials now available, and of others that might become available in significant amounts if facilities for processing were to be established. Is the material available in the area at a relatively low cost compared with the cost in other areas and with the cost of the material when imported? Is it potentially obtainable at low cost? How much time and how much investment might be required to realize these potentialities? Is the material available in large enough quantities for a manufacturing operation of economic size? Is the supply steady? Is it a resource that may be exhausted in a few years? At what locations is it available? What are the transport facilities and the transport costs from these locations to possible manufacturing sites and to the area's local markets and export markets?

There are many important vegetable raw materials of industry, such as cotton, vegetable oil seeds and nuts, rubber, waxes, cacao, sugar, hardwoods, and softwoods. Many of these are so readily

transportable in a crude state, however, that their presence does not necessarily give much economic advantage to processing industries that might be established near them. As always, the market "pull" and the "pull" of other resources needed in the particular kind of manufacturing have to be weighed against that of the raw material. The canned food industry is one for which the presence of appropriate agricultural materials provides a good economic foundation, because of the perishable and bulky nature of the materials. In Mexico, henequen has provided a raw material base for manufacture of binder twine and cordage for export. Forest resources of appropriate types may, with development of a lumbering and milling industry, be the raw material base for furniture manufacture.

There should also be an inventory of mineral resources. If the area has not had a comprehensive geological survey it will generally be worthwhile to provide for one in order to obtain information for industrial planning. The geological survey should be directed not only at the more spectacular minerals, such as metals and petroleum, but also at such common, everyday needs of an industrial economy as limestone for making cement, clay of different types suitable for bricks, tile, and other ceramic uses, quartz sand suitable for glass making, and water, which is needed in large quantities by paper mills, steel plants, food canning, and many chemical industries.

It is important to ascertain not merely the existence of various minerals but precise details about their occurrence and quality. Location will obviously have much to do with determining industrial usability. So will the assocation of other minerals with the principal ones, because some combinations make the process of separation very costly and practically destroy the industrial value of the deposit, while others give valuable by-products. Among the references cited at the end of this chapter are some which describe systematically, for each of many minerals, the industrial uses to which the mineral is put, the specifications it should meet in order to be well suited to particular uses, and such related facts as the processes used in refining it and its price history in recent years.

The inventory should ascertain what sources of power are available in the area, including hydroelectric power and power obtained by the burning of various fuels, and at what estimated cost industrial power can be obtained now or after appropriate development. Argentina and some of the Caribbean islands, for example, have to contend with inadequate domestic supplies of fuel. Is the situation in the area one that suggests industries requiring very large amounts of very low cost power (such as the refining of aluminum) or does it, on the contrary,

suggest that only industries in which power costs are not too significant should be considered?

Where there are good supplies of such raw materials as petroleum, coal, salt, limestone, sulfur, etc., and if the necessary technical skills and capital seem to be obtainable, exploration of possibilities in basic chemical manufacturing will naturally suggest themselves. The size of the market that can be served is likely to be a determining factor in this connection, as has been repeatedly emphasized. In some areas chemical intermediates, such as sulfuric acid, caustic soda, ammonia, and nitric acid, will already be available at reasonably low cost from an already existing basic chemical industry or by importation (or a combination of the two). If so, there may be prospects for success in some of the many chemically-based industries that convert these intermediates into still more highly manufactured products. The nonspecialist who wants to evaluate the possibilities in chemical industries runs into an exceedingly complex maze of technical and economic interrelationships and must turn to a specialist in these industries. Certain references at the end of the chapter will be helpful to specialists and nonspecialists alike.

The resource inventory should not neglect to consider the availability in the area, either from local manufacture or by importation, of partly manufactured products and component parts which might form the basis of further manufacture and of assembly operations. Oftentimes the final operations of a manufacturing process can be carried out more economically close to a market and in touch with its special needs and whims. This is one good way to begin to acquire manufacturing experience, and it has the advantage that as industrial experience accumulates and the market grows it may be possible to work back toward the manufacture of more and more of the components.

Finally, there may be natural or economic obstacles to the industrial use of one resource which could be overcome by bringing certain others into use at the same time. For example, the development of a possible source of hydroelectric power in combination with projects for beneficiation of ores and for processing of pulpwood might be feasible, even where no one of the three would be economically feasible as a single development.

Facilities and Equipment

The inventory will also pay attention, of course, to existing industrial installations, including suitable factory sites and the necessary utilities, such as gas, water, electric power, railroad and highway facilities, and so on. How costly is it to obtain various kinds of machinery and equipment? What of repair facilities? If there is machinery or equipment in an area which is not being thoroughly utilized and which might be converted to other uses at moderate cost, this is another fact worth noting.

Capital for Investment in Manufacturing

In most of the countries of Latin America, and the industrially less-developed countries generally, capital available for investment in manufacturing is one of the scarcest resources. The cause is twofold: (1) a low capacity to save, because of the relatively low productivities and incomes of such countries, and (2) the habits, attitudes, lack of experience, lack of developed financial institutions, and lack of markets which prevent actual or potential savings from being channeled into industrial development. Therefore, industrial capital is usually expensive in these countries as compared with the cost of capital in the industrially more advanced countries. Wage rates of labor, on the other hand, are generally lower than in the industrially advanced countries, because the productivity of labor is lower, not only in manufacturing but in practically any alternative activity in which it might engage, notably in agriculture. Where this situation does exist—and it is practically universal in the countries of Latin America and other regions now seeking to catch up in industrial development—it imposes an economic handicap on industries requiring especially large amounts of capital and tends to favor industries in which the capital works with relatively large amounts of labor and other comparatively abundant resources. It does not, however, absolutely rule out so-called capital-intensive industries—that is, industries in which capital costs are a large part of total costs. Some capital-intensive industries will be so productive as to more than offset the high cost of the capital factor.

It is important, therefore, as a part of the basis for making intelligent decisions on the types of manufacturing industry most suitable for an area, to compile information on the ease or difficulty with which capital may be obtained for use in manufacturing and on the cost of such capital. The cost of capital is indicated by the annual rate of interest that must be paid on industrical loans, or by the rate of return on investments which is necessary to induce owners of capital funds to put their money into industrial enterprises.

The inventory of available capital for manufacturing should take account not only of local sources of capital, but also of the possibilities of and costs of attracting capital from outside.

REFERENCES, CHAPTER VI

1. An excellent general treatise, which starts with an outstanding discussion of resource appraisal in its very broadest aspects and contains fairly detailed descriptions of many segments of modern industry with special attention to their resource base, is:

Zimmermann, Erich W. World Resources and Industries: A Functional Appraisal of the Availability of Agricultural and Industrial Materials. Rev. ed. New York: Harper & Brothers, 1951.

Also useful over a wide range of materials and industries is the monumental compendium of the Woytinskys:

Woytinsky, W. S., and E. S. Woytinsky. World Population and Production: Trends and Outlook. New York: Twentieth Century Fund, 1953.

Specialized references to particular kinds of resources and their industrial uses follow:

Products of Agriculture and Forestry

Zimmermann's book cited above has chapters on the industrial resources originating in agriculture and forestry. Each chapter has a well-selected bibliography.

A brochure designed to assist in area development work is:

United States Department of Commerce, Office of Domestic Commerce, Area Development Division. Industrial Uses of Selected Timber Species and Forest Waste Material. Industrial Series No. 69, June, 1947.

Mineral Resources

Zimmermann's book cited above has chapters on mineral resources and their use in industries, with select bibliographies. Special attention is given to energy sources: coal, petroleum, natural gas, and water power.

Another good general reference is the atlas, The Mineral Resources of the World, listed below. It maps and describes the main world sources for each of twenty-nine minerals of greatest commercial importance and presents brief accounts of the industrial uses and importance of each. It also describes the geologic occurrence, physical and chemical properties desirable for use in industry, mining methods, and techniques of preparing the mineral for industrial use. Select bibliographies are included.

Van Royen, William, Oliver Bowles, and Elmer W. Pehrson. The Mineral Resources of the World. New York: Prentice-Hall, for the University of Maryland, 1952.

The following brochure, designed to assist in area development work, tabulates the main industrial uses of each of a large number of minerals:

United States Department of Commerce, Office of Domestic Commerce, Area Development Division. Industrial Uses of Selected Minerals: Guide List of Industrial Uses of Mineral Resources. Industrial Series No. 72. 1947.

Two reference works containing descriptions of the industrial uses of nonmetallic minerals, with information on grades and specifications, preparation for the market, and bibliography are:

American Institute of Mining and Metallurgical Engineers, Committee on Industrial Minerals Volume (Samuel H. Dolbear, Chairman). Industrial Minerals and Rocks. 2d. ed., New York: A. I. M. E. 1949.

Ladoo, Raymond B., and W. M. Myers. Nonmetallic Minerals. 2d ed. New York: McGraw-Hill Book Company, 1951.

The United States Bureau of Mines, Department of the Interior, with the cooperation of the United States Geological Survey, has compiled a number of exhaustive reports for the National Security Resources Board in connection with a survey of strategic and critical materials. Each report deals with one material and presents its properties, products, and uses, the major methods of obtaining and processing it, the United States and world supply position, and related information. Issued or scheduled for future issue: Asbestos, Antimony, Copper, Lead, Manganese, Nickel, Zinc, Aluminum, Bauxite, Beryllium, Chromium, Cobalt, Iron Ore, Iron and Steel Scrap, Tin, Tungsten.

The annual Minerals Yearbook issued by the United States Bureau of Mines includes current information bearing on industrial uses and specifications, as well as statistics of United States and world mineral production and consumption.

Industrial Chemical Resources

The following references are selected because they pay special attention to the economic aspects of raw materials, processes, and products in the chemical industries.

Faith, W. L., Donald B. Keyes, and Ronald L. Clark. Industrial Chemicals. New York: John Wiley & Sons, 1950. Relatively brief compilation of important technical and economic data concerning the major industrial chemicals.

Perry, John H., ed., Chemical Business Handbook. New York: McGraw-Hill Book Company, 1954. A comprehensive training and reference work, dealing with all aspects of the chemical business. Section VI contains a detailed guide to uses of chemical materials and products and to sources of information for chemical market research, with many references.

Snell, Foster Dee, and Cornelia T. Snell. Chemicals of Commerce. 2d. ed. New York: D. Van Nostrand, 1952. Brief summaries on the industrial uses and composition of important chemicals and commercial facts about them.

Stanford Research Institute, Chemical Economics Handbook Staff. Product Flow Charts of the United States Chemical Industry. Stanford, California: published by the Institute, 1954. Shows the product flow in the organic and inorganic chemical industries from chemical raw material to final chemical product and end-use.

Chapter VII

MATCHING INDUSTRIES TO DEMANDS AND RESOURCES

Having analyzed demands and resources, the next step is to analyze industries with a view to finding those which best match the area's demands and resources. We need to know certain things about each industry that is being considered as possibly appropriate for development in the area.

First, as to the industry's output characteristics (which must be matched to demands) information is needed on its products, the type of market for which it produces, the required marketing facilities, and the scale of operation that is necessary in order to produce at reasonably low cost.

Second, as to its input characteristics (to be matched to resources) information is needed on requirements for materials, machinery and equipment, buildings and utilities, fuel and power, labor and managerial personnel, and supporting services.

Third, we need to know key location factors in the industry, such as a characteristic orientation toward markets, or toward raw materials, or power, or labor supply, in order that these can be compared with the situation in the area being developed.

Exhibit VII-1 outlines the questions that should be asked and answered in determining whether a particular type of manufacturing seems well enough suited to the area to justify preliminary selection as a candidate industry.

A Check List

In Appendix A a check list of modern manufacturing industries is presented. This has been compiled, with some adaptations for present purposes, from the "Standard Industrial Classification" used by the United States Government in collecting manufacturing statistics. It therefore covers almost every type of modern manufacturing. One way to compile a list of candidate industries would be to work through this check list item by item, considering for each type of manufacturing three questions:

1. Does this industry turn out products for which there is likely to be a strong effective demand in the area (or in its export

Exhibit VII-I

INDUSTRY CHARACTERISTICS PERTINENT TO SELECTION OF CANDIDATE INDUSTRIES

Output Characteristics

1. Product.

   What kinds of goods does the industry produce?

   Are these goods of a type for which there is a strong actual or prospective demand in the area or in accessible export markets?

2. Marketing.

   What distribution channels and facilities are required? What special quality standards must be met? What is the nature of the competition in the industry?

   In the light of these characteristics, are conditions in the the area highly favorable for development of the industry, moderately so, or unfavorable?

3. Efficient scale of operation.

   To what extent does low-cost production in the industry depend on having a large output? What is the minimum size of plant that can be reasonably efficient and able to meet competition?

   Is the actual or prospective demand large enough to support at least one plant of such size?

Input Characteristics

What are the requirements of the industry for each of the following types of resources?

1. Materials.

2. Machinery and equipment.

3. Buildings and utilities.

Exhibit VII-1 (Continued)

4. Energy (fuel and power).

5. Personnel (unskilled, skilled, supervisory, technical, managerial).

6. Supporting services.

Are there any essential requirements missing in the area? Are the requirements that bulk largest in determining the cost of the product available in the area on highly favorable, moderately favorable, or unfavorable terms?

Key Location Factors

1. Nearness to markets.

   Is the industry one that is characteristically "market-oriented?"

   If so, are there markets in the area that are large and concentrated enough to exert a strong "pull" on this industry?

2. Nearness to materials and energy.

   Is the industry one that is characteristically "materials-oriented?" "Energy-oriented?"

   If so, are there abundant and low-cost sources in the area of the particular materials or the types of fuel and power which attract this industry?

3. Manufacturing costs.

   Is the industry one that is characteristically oriented toward areas of low factory operating costs—for example, low labor costs, low capital costs, low taxes and real estate costs?

   If so, are the factory costs most important to this industry highly favorable, moderately favorable, or unfavorable in the area?

Exhibit VII-1 (Continued)

4. Geographical concentration or scattering.

Is the industry characterized by a tendency to geographical concentration or by wide scattering?

If the former, what factors seem to account for the tendency to concentrate, and are these factors favorable to location of the industry in the area? If the latter, does this suggest that one or more producing units may be suitable for the area?

markets), and for which the volume of demand will be enough to support at least one plant of economic size?

2. Does this industry use resources which are in good supply at relatively low cost in the area?

3. Are the key cost factors in this industry ones that seem to favor location in the area?

An industry which rates very low on any one of these tests should be passed over. An industry which shows up to special advantage on one or more of the tests and rates moderately well on all three should be marked for further consideration. The best of these should then be selected as candidate industries.

Industry Information

Ideally, every person or organization engaged in selecting suitable industries for a developing area should have at hand reliable information on the outstanding characteristics of every industry in the whole range of industrial possibilities. It would be desirable to know, for example:

How large a market is necessary for various kinds of iron and steel products before it becomes economic to establish a rolling mill? A blast furnace? A foundry? An integrated steel industry? What are the various materials that enter into these manufacturing operations? To what extent can one type of material be substituted for another? How important is the cost of the materials in determining the total costs of the enterprise? What is the role of capital costs? Labor costs?

Does the manufacture of tires, for example, require a higher or lower capital investment for a given value of output than the manufacture of tin cans, wood furniture, or electric motors? How important is it to be assured of a high level of labor skill, or experienced supervision, or a technical engineering staff before embarking on the manufacture of, say, rubber shoes, molded plastics, wearing apparel, insecticides, or radio tubes?

In practice those who have to make strategic decisions with respect to the direction to be taken by industrial development in a newly developing area will nowhere find the needed information on industry characteristics in readily usable form, at least for any wide range of industries. A decade ago, A. J. Brown, a British

economist, writing on Industrialization and Trade, spoke particularly of the need to know the proportion in which the different factors of production are used in different industries or different technical processes. What he said then remains true today: "In principle, this knowledge should be more easily obtainable than that concerning natural resources, but, in fact, the published sources of it are fragmentary in the extreme."[1]

Since there is no comprehensive reference work on the technical and economic characteristics of different kinds of manufacturing, the only recourse is to gather information on one or a few industries at a time, hoping that this will give a reasonably accurate basis for the comparisons that are necessary in rating one industry against another. The following sources will be found useful:

1. Textbooks, treatises, and research studies on manufacturing industry, including problems of plant location. Some of these books will be quite helpful, but none gives exactly the type of practical information that is needed. In the references at the end of the chapter we have listed a few examples from this literature.[2] We have chosen only books that deal with a fairly wide range of industries. References found in these will provide a guide to some of the specialized works on single industries. There is an enormous literature, of course, devoted to particular industries.

2. Industrial periodicals. These are for the most part highly specialized.

3. Equipment manufacturers. This, too, is a highly specialized source of information and one more likely to be useful in the later stages of planning for the actual launching of a manufacturing enterprise than in the preliminary stage of selecting candidate industries from a broad field.

4. Trade and industry associations. Frequently they have publications which are helpful, but again in a specialized field.

5. Professional industrial consultants. Industrial economists and industrial engineers, or teams of them made up of individuals with different specialties, such as can be provided by some consulting organizations, can often bring a broad knowledge of the possibilities and requirements of different industries.

As a supplement to this Manual (Appendix B) six "Industry Profiles" are presented. Each "profile" sketches the economic and technical

characteristics of one line of manufacturing, stressing the points that should be taken into account in deciding whether this type of industry is suitable for development in a particular area. The following industries are analyzed:

Food Canning Industry
Can Manufacturing
Plastics Products
Cement Industry
Bottled Soft Drink Industry
Rubber Products

Obviously, these profiles cover only a few corners of the whole field of manufacturing industry. They will serve, however, to show by concrete example what kinds of industry information must be acquired and weighed when choosing candidate industries. Also, the reference lists appended to them will illustrate the types of sources from which industry information can be gathered.

The Foreign Operations Administration of the United States government has recently issued a number of small brochures, prepared for it by engineering consultants, under such titles as "Requirements for Planning a Gray Iron Foundry," and "Requirements for a Plant to Manufacture Toilet and Laundry Soap." These are concerned mainly with physical plant and equipment. They give concrete indications of capital and labor requirements for small-scale factories in the specific lines dealt with.[3]

SOME STATISTICAL STUDIES OF INDUSTRY CHARACTERISTICS

Statistical studies can help to give a general idea of the average characteristics found in a number of broad segments of industry. We can ascertain in this way what segments of modern manufacturing characteristically have very large plants and what others favor smaller-scale operation. Also, we can get some inkling of the relative importance in different industrial sectors of capital costs, labor costs, energy costs, materials costs, and of the effects of costs of transport and distribution in favoring locations near to markets or near to certain types of resources.

A grave defect of such studies, for the purposes with which this Manual is concerned, is that they are available at present only for some of the more highly advanced industrial countries. We learn,

therefore, about the prevailing size of plant, use of materials, energy, labor, and capital equipment in these countries. The results show rather substantial similarities as between the United States, Great Britain, Australia, and other countries for which the necessary detailed industrial statistics are available. For example, industries characterized by large plants in one of these countries are, by and large, also characterized by large plants in the others. But it would be much better, for our purposes, to be able to compare this information with data from a number of the industrially less-developed countries where some industries have been established. This would help to show which industry characteristics are made necessary by the technology of the industry, and are therefore found in any country, and which merely reflect the special circumstances that exist in the more highly developed economies.

Other defects of the available studies are that some of them are based on industrial censuses now rather old (not too serious for our purposes) and that census classifications inevitably group together plants that manufacture somewhat different commodities. Plants that make a number of products are reported as though their entire equipment and work force were engaged in making the principal product. Thus, we get a rather blurred picture of "average" conditions in factories that are classified in the same industry group but may be really engaged in making different products.

We have debated whether the foregoing reasons should lead us to omit altogether the statistical information on industry characteristics which follows. As the careful reader will observe, contradictory indications can be found in the different studies reported. It seems best, however, to provide a summary of the best information of this type that is available, with due warning of its shortcomings. Characteristics of various types of manufacturing brought out by the statistics of the more advanced industrial countries do have some indicative value for those concerned with development programs elsewhere. And there is some advantage in being alerted to the inconsistencies that are inevitable in studies of this kind, so that no single result will be overvalued.

Scale of Operation

Production on a very large scale is necessary in some manufacturing industries in order to achieve low cost per unit of output. Thus, a summary of certain studies on iron and steel manufacturing made for the Economic Commission for Latin America suggests that one of the most important factors bearing on the cost of steel-

making is the size of plant. The cost of finished steel, according to estimates charted in these studies, falls sharply with larger plant capacities until a plant size of about 250,000 tons a year is reached. The cost falls less sharply from that point to about 700,000 tons capacity, and falls slowly after that. The ECLA experts discuss "critical size," meaning the scale of operation necessary in a given country of Latin America to achieve a cost low enough to be competitive with the delivered cost of steel from a large plant in the United States. They point out that where the costs of the raw materials are especially low and where transportation costs are favorable, this critical size is smaller than would otherwise be the case. Where these factors are unfavorable the critical size is larger.[4]

In countries at the early stages of industrial development the size of the market for all types of manufactured goods is bound to be fairly small (unless a large export market can be cultivated). Therefore, those manufacturing industries which can attain a high degree of efficiency and low-cost operation in fairly small plants are more suitable than those which require a very large scale of operation. Other factors besides the small size of the market also tend to limit the feasible scale of operation of manufacturing industries in some of the less-industrialized countries. Thus, an ECLA study of productivity in the cotton textile industry in five Latin-American countries remarks, "The principal cause for the small size of the textile mills in the countries visited is the lack of capital concentration in the hands of a single firm. This can be ascribed to the characteristic individualism of many Latin-American manufacturers. The limited size of the market, which is frequently referred to as another of the main causes, has no general importance in this connection (except probably in Ecuador), because the volume of domestic demand for textiles is several times greater than total production of an optimum size mill. . . ."[5]

Industries characterized by small-scale, medium-scale, and large-scale plants, according to the United States Census of Manufactures of 1947, are shown in Exhibit VII-2.

British industries are grouped according to prevailing size of establishment in Exhibit VII-3. This table is based on census data for 1930 and 1935, analyzed by P. Sargant Florence, of the University of Birmingham.

Plant size in these tables is measured by number of workers. In some cases, for example in flour milling, the small number of workers per plant may be the result of a very high degree of mechanization. In such cases the plant may be large in terms of capital investment and in terms of the required size of market.

Exhibit VII-2

SIZE OF PLANTS IN UNITED STATES INDUSTRIES, 1947

Small-scale Plants	Average Number of Workers per Establishment
Baking, bread	25
Flour milling	25
Paints and varnishes	27
Women's and misses' dresses	28
Women's and children's undergarments	34
Pharmaceutical products	37
Special industrial machinery	46
Cigars	54
Frozen foods	54
Canning and preserving	54
Medium-scale Plants	
Meat products, except poultry	59
Clothing, men's and boys' suits and coats	73
Pottery and related products	78
Clothing, men's shirts	83
Leather tanning	87
Full-fashioned hosiery	88
Liquor, distilled	114
Baking, biscuits and crackers	115
Clothing, work shirts	131
Liquor, malt	145
Beet sugar	157
Shoes	164
Machine tools	174
Rayon and related woven fabrics	180
Paper and paperboard	194
Cement	198
Pulp	201
Chemicals, industrial	239
Woolen and worsted manufacturing	247
Petroleum refining	261
Glass, pressed and blown ware	297
Rubber, synthetic	301
Shipbuilding and repairing	381

Exhibit VII-2 (Continued)

Large-scale Plants	Average Number of Workers per Establishment
Glass, containers	482
Copper, smelting and refining	484
Cotton, broad-woven goods	569
Motor vehicles and parts	580
Cane-sugar refining	604
Aluminum, primary	667
Glass, flatware	715
Cigarettes	913
Rubber footwear	921
Rubber, tires and tubes	1,648
Aircraft	1,902
Steelworks and rolling mills	2,038

Source: Alderfer, E. B., and H. E. Michl. Economics of American Industry. New York: McGraw-Hill Book Company, 1950, p. 11. Based upon Census of Manufactures, 1947.

The plant size prevailing in a given industry in the United States or Great Britain does not necessarily mean that the industry must operate on this scale in order to attain reasonable economic efficiency in an industrially less-developed country. The scale of operation in the highly industrialized countries is only partly a consequence of technological factors (such as minimum and maximum size of furnaces, lathes, sewing machines, and other items of industrial equipment, and the number of machines that can be effectively supervised). Also important are the nature and extent of the market, transportation and communication conditions, and the relative prices of capital equipment, labor, managerial skills, and the other factors of production. In many industries there is room for considerable flexibility in production methods, and often there is a very wide range of plant sizes within the same industry. It is necessary to study the technology of production of each product in order to determine whether a large scale of operation is technologically necessary or whether the industry can be adapted to smaller-scale production without too great a loss in efficiency. We do not really know as yet what can be done in various lines of manufacturing if good engineering talent is devoted to the problem of deliberately redesigning modern manufacturing processes for smaller-scale operation and for the saving of capital costs in countries where capital is scarce and expensive.

Costs of the Productive Factors

Industries differ greatly in the nature of their input requirements. In some, the cost of the final product consists largely of the costs of the raw materials that go into it. Expenses due to labor and the use of machines, buildings, and other capital equipment are relatively minor. In others, materials costs are fairly small, but a very large amount of power is required for producing each unit of output. In that case the cost of the product is likely to depend significantly on the cost of power. In some industries the production process is so highly mechanized, or requires such large and expensive equipment, or such large amounts of working capital, that a major item in the cost of the final product is capital cost—depreciation, and payments for the loan or investment of capital. In still other industries the labor that has to be applied to produce the final product represents by far the heaviest cost, so that wage rates and the skill and efficiency of labor are key cost factors.

One type of input or "productive factor" may often be substituted for another, within limits set by technology. By applying more labor it may be possible to conserve materials, or to keep

Exhibit VII-3

SIZE OF PLANTS IN BRITISH INDUSTRIES, 1930 AND 1935

Small Plants Prevalent

Aerated waters, cider, etc.
Bread, cakes, etc.
Building and contracting
Canvas
Carriage
Fish-curing
Flock and rag
Fur
Furniture
Millinery, etc.
Motor repairing
Nonmetal mines and quarries
Packing
Retail bespoke tailoring
Shoe repair
Timber (sawmilling, etc.)
Umbrella

Smallish Plants Prevalent

Bottling, wholesale
Brass, finished
Brick and fireclay
Building materials
Glove
Lace
Leather-tanning and dressing
Oil and tallow
Saddlery
Wooden crates

Tendency Toward Smaller Sizes

Aprons, overalls, etc.
Bacon-curing
Cardboard boxes
Foods, cattle
Grain-milling
Hardware, other
Paint
Plate and jewelry
Sport requisites

Exhibit VII-3 (Continued)

Medium Plants Prevalent

Aluminium, etc. smelting and rolling
Blast furnace
Butter, cheese, margarine
Cement
Chain, nail and screw
China and earthenware
Coke and by-products
Constructional engineering
Corsets
Cotton spinning
Cotton weaving
Hat and cap
Jute
Mackintosh
Metalliferous mining
Paper
Scientific instruments
Shirt
Tool
Wholesale tailoring
Wire
Wool and worsted

Largish Plants Prevalent

Chemicals, others
Cocoa and sugar-confectionery
Electric heating and cooking apparatus
Gas undertakings
Glass
Machine tool
Newspaper
Rail carriage and wagon
Soap
Wholesale bespoke tailoring
Electric valves
Tube, wrought iron and steel

Exhibit VII-3 (Continued)

Tendency Toward Larger Sizes

Batteries
Dyes
Explosives
Linen
Slate mines
Sugar and glucose
Tin-boxes
Tinplate

Large Plants Prevalent

Aircraft
Biscuit
Coal-mining
Electric machinery
Electric wires and cables
Iron and steel rolling and smelting
Linoleum and oilcloth
Marine engineering
Motor and cycle manufacturing
Prime mover
Rubber
Shipbuilding
Silk and artificial silk
Tobacco and cigarettes
Wireless

All Sizes

Brewing
Copper and brass
Electric light fittings
Electricity undertakings
Food, preserved
Foundry
Games and toys
Hosiery
Mechanical engineering, other
Printing and bookbinding
Printing machinery
Seed-crushing
Textile machinery

Exhibit VII-3 (Continued)

Source: Florence, P. Sargant, assisted by W. Baldamus. Investment, Location, and Size of Plant. Cambridge (England): the University Press, 1948. Adapted from Appendix II, pp. 168-175. The grouping into prevalent sizes is based on number of employees.

machines running more constantly and thus get along with less capital investment. A larger investment in materials-handling equipment and other machinery may save on labor costs, but at the expense of greater capital costs.

"There is no such thing as a 'most efficient' combination for a given process in a purely technical sense without regard to the relative prices of the factors used."[6] This applies both to the choice of the most suitable process within an industry and to the choice of the most suitable industry to be undertaken within a given area. Where capital is relatively abundant and low-priced and labor high-priced, the greatest economic efficiency will usually be promoted by choosing industries and processes that use comparatively large amounts of capital and comparatively small amounts of labor to produce a given output. Thus, in the highly industrialized countries like the United States it pays to use machines and equipment lavishly in order to save labor time. In the less industrialized countries, on the other hand, labor time tends to be less costly and capital more costly. It is particularly important in such countries, at this stage in development, to find ways of economizing on capital. One way is to find industries that permit a high output with relatively little capital, even though somewhat more labor is required.

Besides the scarcity and relatively high cost of investment capital in the industrially less-developed countries, the first cost of the machines themselves and their maintenance and repair are likely to be high as compared with these costs in the more industrialized countries. For example, in Chile, according to the ECLA survey of Latin-American textile industries cited earlier, the cost of textile machinery was found to be about 6.5 pesos per loom-hour and the cost of textile labor about 18 pesos per man-hour. Similar costs were calculated for the United States at 7.3¢ per loom-hour and 98¢ per man-hour. The ratio between the price of a loom-hour and the price of a man-hour was nearly five times as high in Chile as in the United States.

In general, a country will be ahead whenever it can use a lower-cost factor instead of a higher-cost factor to produce an output of equivalent value. The problem is always to find the most economic and productive balance. This balance changes as development proceeds. Furthermore, as will be emphasized in the next chapter, the real value of an industry to a country depends upon the total net return it brings to the economy, considering all the benefits to the economy and all the costs. An industry which makes heavy use of capital could nevertheless be so productive in some circumstances as to more than offset the high cost of the capital in a capital-scarce country.

Capital Use

Kenneth A. Bohr of the staff of the International Bank for Reconstruction and Development has studied the relative capital requirements of different industries in several countries for which data can be obtained.[8] His measure of capital requirement is the ratio of fixed capital to value added by manufacture. Though the data have shortcomings, they are considered to be suitable measures of relative capital requirements among different industries in which many firms are reporting.

When industries in several countries are ranked according to capital requirements the rankings turn out to be fairly consistent. Clothing, electrical equipment, leather products, and furniture have relatively low capital requirements in all cases. The requirements for textiles vary, but are relatively low in a number of cases. Chemicals, nonmetallic minerals (bricks, cement, etc.) and paper appear to have relatively high capital requirements in all cases; while food, drink and tobacco have high requirements in most cases. Bohr's rankings for twenty industries in Australia and the United States are shown in Exhibit VII-4.

A quite different approach to the comparison of capital intensity in different industries was used by P. Sargant Florence in his study already cited. He concluded, after weighing the pros and cons of various measures, that the best available index would be horsepower per worker. His data permit a much more detailed breakdown of industries, but are based on conditions of more than two decades ago. See Exhibit VII-5.

Labor and Supervision

Exhibit VII-6 shows the ratio of total wages paid in a number of United States industries to the value of the product (that is, to sales revenue) in those industries. In some of the industries where labor costs are relatively low the principal cost item is raw materials. In others a high proportion of the costs are devoted to machinery and equipment, or to machinery and equipment plus raw materials. Even in the high-labor-cost industries wages were less than half of the value of the product.

Industries differ greatly in their skill requirements. Scarcity of skilled workers, and especially of skilled supervisory, technical, and professional personnel, may be as great an obstacle as the scarcity of capital to the development of manufacturing in less-industrialized countries. The two factors sometimes have to be weighed against

Exhibit VII-4

INDUSTRIES RANKED IN ORDER OF INCREASING RATIOS OF FIXED CAPITAL TO VALUE ADDED BY MANUFACTURE

Industries	Rank: Australia 1946-47	Rank: United States 1939
Shoes	1	2
Clothing	2	1
Leather products	3	4
Electrical equipment	4	3
Furniture	5	6
Rubber goods	6	10
Textiles	7	17
Motor cars and aircraft	8	12
Fabricated metal products	9	7
Sawmills and woodworking	10	14
Agricultural machinery	11	13
Iron and steel foundries	12	15
Printing and publishing	13	5
Nonferrous metal fabricating	14	9
Transport equipment	15	8
Paper	16	16
Nonmetallic minerals	17	19
Food, drink, and tobacco	18	11
Chemicals	19	18
Coke	20	20

Source: Bohr, Kenneth A. "Investment Criteria for Manufacturing Industries in Underdeveloped Countries." The Review of Economics and Statistics, May 1954, p. 162. The Australian data are based on the Commonwealth Bureau of Census and Statistics, Production Bulletin 1946-47. U. S. data are based on W. Leontief, Studies in the Structure of the American Economy, 1953, and on the U. S. Census of Manufactures, 1939.

Exhibit VII-5

INDUSTRIES RANKED IN ORDER OF INCREASING HORSEPOWER PER WORKER

Industries	Rank: Great Britain 1930	Rank: United States 1929
Tailoring and dressmaking	1	1
Shirts and undergarments	2	2
Fish-curing and canning	3	24
Corsets	4	3
Saddlery and harness	5	16
Glove, leather	6	4
Hosiery	7	9
Fur	8	8
Boot and shoe making	9	7
Tobacco, cigars, cigarettes	10	5
Games and toys	11	20
Hat and cap	12	14
Cardboard boxes	13	21
Manufactured stationery	14	13
Electric light fittings	15	25
Elastic webbing	16	18
Pens, pencils, and artists' materials	17	22
Lace	18	23
China and earthenware	19	26
Scientific instruments	20	28
Brush	21	17
Needle	22	10
Bread and biscuit	23	29
Printing and bookbinding	24	15
Aerated waters	25	62
Sports requisites	26	27
Safes	27	48
Furniture	28	36
Umbrella	29	11
Plate and jewelry	30	19
Aircraft	31	12
Drugs	32	31
Carriages	33	42
Fancy articles and semifinished plastic	34	6
Preserved food	35	32

Exhibit VII-5 (Continued)

Industries (Continued)	Rank: Great Britain 1930	Rank: United States 1929
Wallpaper	36	38
Linen and hemp	37	57
Motor and cycle manufacturing	38	47
Agricultural machinery	39	44
Cocoa and sugar confectionery	40	35
Musical instruments	41	39
Cutlery	42	46
Electrical engineering	43	40
Silk and artificial silk	44	34
Textile machinery	45	33
Iron foundry	46	51
Explosives	47	56
Newspaper printing	48	37
Building materials	49	52
Rope, twine and net	50	59
Chain, nail, bolts and screws	51	60
Woolen and worsted	52	50
Jute	53	72
Soap, candle and perfumery	54	41
Other mechanical engineering (typewriters, sewing machines, refrigerators, etc.)	55	30
Asbestos	56	58
Glass	57	55
Oil and tallow	58	73
Leather tanning	59	54
Wood crates	60	53
Shipbuilding	61	68
Tools	62	45
Butter, cheese, and margarine	63	74
Bricks	64	65
Machine tools	65	43
Timber	66	61
Textile finishing	67	49
Paint, colour varnish	68	69
Cotton spinning and weaving	69	63
Prime mover (engines, turbines, locomotives)	70	64
Prepared feeds	71	79

Exhibit VII-5 (Continued)

Industries (Continued)	Rank: Great Britain 1930	Rank: United States 1929
Rubber	72	70
Rail carriage	73	66
Linoleum	74	75
Wire	75	71
Tube	76	67
Sugar and glucose	77	77
Petrol refining	78	76
Coke and by-products	79	82
Other chemical products	80	78
Seed-crushing	81	80
Grain-mill	82	84
Paper	83	83
Iron and steel smelting, rolling, blast furnace	84	81
Cement	85	85

Source: Florence, P. Sargant, assisted by W. Baldamus. Investment, Location, and Size of Plant. Cambridge (England): the University Press, 1948. Adapted from Table A. pp. 178-83.

Exhibit VII-6

ROLE OF LABOR COSTS IN CERTAIN UNITED STATES INDUSTRIES, 1947

Low Labor Cost Industries	Wages as Percent of Value of Product
Flour milling	3.4
Cane-sugar refining	4.8
Cigarettes	4.9
Petroleum refining	6.0
Meat products, except poultry	6.3
Liquor, distilled	7.1
Paints and varnishes	7.5
Rubber, synthetic	7.8
Medium Labor Cost Industries	
Beet sugar	11.4
Leather tanning	12.2
Aluminum, primary	13.0
Baking, bread	13.4
Chemicals, industrial	13.5
Paper and paperboard	13.6
Pulp	13.6
Canning and preserving	14.3
Baking, biscuits and crackers	14.4
Clothing, work shirts	14.6
Women's and children's undergarments	15.0
Liquor, malt	15.9
Frozen foods	16.6
Clothing, men's shirts	18.8
Cement	19.5
Rubber, tires and tubes	20.1
Rayon and related woven fabrics	20.4
Cotton, broad-woven goods	21.2
Woolen and worsted manufacturing	21.7
Women's and misses' dresses	21.8
Cigars	22.0
Clothing, men's and boys' suits and coats	23.5
Shoes	24.5

Exhibit VII-6 (Continued)

High Labor Cost Industries	Wages as Percent of Value of Product
Special industrial machinery	25.1
Glass, containers	25.3
Rubber footwear	29.4
Full-fashioned hosiery	29.4
Machine tools	33.1
Glass, pressed and blown ware	37.0
Pottery and related products	42.4
Shipbuilding and repairing	43.9

Source: Alderfer, E. B., and H. E. Michl. Economics of American Industry. New York: McGraw-Hill Book Company, 1950, p. 12. Based upon Census of Manufactures, 1947.

each other, for investment of more capital in automatic types of machinery may be a means of getting along without so much need for skilled supervisory labor or skilled craftsmen. The net balance of cost advantage will depend on the circumstances of each case. The skill requirement is a factor which must be carefully considered in matching the characteristics of an industry against the resources of a developing area.

Some indication of the types of industry in which skill requirements are likely to be particularly significant is given in Exhibit VII-7. A number of United States industries are arranged according to the percentage of skilled workers, foremen, and professional persons to the total employed by the industry.

Costs of Materials and Energy

Exhibit VII-8 shows the varying role of materials costs in different industries. In some, the value of the product consists mainly of the value of the raw materials embodied in it. This does not always mean, however, that the industry will operate most economically and be most successful when located near to its raw materials. Nor does it necessarily mean that an area which has the raw materials for an industry will find that particular industry to be suitable for it. Shipping the raw materials may be easier and cheaper than shipping the finished product. In that case the industry, even though a heavy user of raw materials, will tend to locate near its principal market. Where the raw materials are perishable (food canning) or where much of the weight and bulk of the material disappears in processing (refining of ores) the industry will tend to locate near a raw material source. The locational "pull" exerted on a given industry by a good source of raw materials is likely to vary according to:

1. The proportion of raw materials cost to total cost of the product.

2. Importance of one material, or at most, two or three materials, as opposed to a variety of materials.

3. The necessity of processing materials in successive stages of production.

4. The degree of dependence on specialized materials and the impracticability of using substitutes.

5. The degree of perishability and the cost of protecting materials against deterioration.

Exhibit VII-7

INDUSTRIES GROUPED BY PERCENTAGE OF SKILLED WORKERS, FOREMEN, AND PROFESSIONAL PERSONS TO TOTAL EMPLOYEES, UNITED STATES, 1930

Professional Persons, Foremen, and Skilled Workers as Percent of Total Employees	Industry	
Less than 10 percent	Turpentine farms and distilleries	Potteries
	Gloves	Tanneries
	Shirts, collars, and cuffs	Silk mills
	Cigars and tobacco	Lace and embroidery mills
	Hats	Woolen and worsted mills
	Shoes	Cotton mills
	Leather goods	Slaughtering and packing
	Knitting mills	Buttons
	Fish curing and packing	Bricks, tiles and terra cotta
	Fertilizers	
10 to 20 percent	Hemp, jute, and linen mills	Paint and varnish
	Paper boxes	Glass
	Paper and pulp mills	Soap
	Carpet mills	Rayon
	Fruit and vegetable canning	Saw and planing mills
	Ropes and cordage	Quarries
	Textile dyeing, finishing and printing mills	Lime, cement and artificial stone
	Rubber mills	
20 to 30 percent	Sugar and sugar refining	Blast furnaces and steel rolling mills
	Charcoal and coke works	

Exhibit VII-7 (Continued)

Professional Persons, Foremen, and Skilled Workers as Percent of Total Employees	Industry	
30 to 40 percent	Electrical machinery and supplies Flour and grain mills Agricultural implements	Tinware and enamelware Automobiles Furniture Jewelry
Over 40 percent	Printing, publishing and engraving Marble and stone yards	Suits, coats, and overalls

Source: Bohr, Kenneth A. "Investment Criteria for Manufacturing Industries in Underdeveloped Countries." The Review of Economics and Statistics, May 1954, p. 163. Based on a Bureau of the Census study by Alba M. Edwards used in National Resources Planning Board, Industrial Location and National Resources, December 1942, p. 250.

Exhibit VII-8

MATERIALS COSTS IN SELECTED INDUSTRIES, UNITED STATES, 1947

Low Materials Cost Industries (25-40%)	Materials Cost as Percent of Value of Product
Pottery and related products	25.5
Glass, flatware	28.3
Glass, pressed and blown ware	29.8
Machine tools	30.7
Shipbuilding and repairing	35.2
Pharmaceutical products	35.3
Liquor, malt	38.6
Cement	39.4
Full-fashioned hosiery	39.9
Medium Materials Cost Industries (40-60%)	
Rubber footwear	40.6
Special industrial machinery	41.4
Glass, containers	45.4
Liquor, distilled	45.7
Chemicals, industrial	50.6
Baking, biscuits and crackers	50.9
Rayon and related woven fabrics	51.3
Cotton, broad-woven goods	52.6
Clothing, men's and boys' suits and coats	53.4
Cigars	54.0
Baking, bread	54.9
Women's and misses' dresses	54.9
Pulp	55.7
Woolen and worsted manufacturing	55.8
Shoes	56.6
Rubber, synthetic	58.6
Aluminum, primary	59.7
High Materials Cost Industries (60% and above)	
Clothing, men's shirts	60.0
Women's and children's undergarments	60.4
Rubber, tires and tubes	61.0
Frozen foods	61.7
Leather tanning	62.3
Paints and varnishes	62.4
Paper and paperboard	62.7

Exhibit VII-8 (Continued)

High Materials Cost Industries (60% and above)	Materials Cost as Percent of Value of Product
Canning and preserving	62.8
Clothing, work shirts	65.2
Cigarettes	67.5
Beet sugar	71.3
Petroleum refining	77.4
Flour milling	83.7
Meat products, except poultry	86.3
Cane-sugar refining	89.0

Source: Adapted from Alderfer, E. B., and H. E. Michl. Economics of American Industry. New York: McGraw-Hill, 1950, p. 13. Based upon Census of Manufactures, 1947.

6. The loss in weight or bulk which accompanies the processing of materials, and as a corollary:

7. The expense or effort required for transporting materials compared to that for the product made from them.[9]

Some industries are heavy users of energy--that is, fuel and power. They are therefore attracted to large and cheap supplies of such commodities as coal, petroleum, natural gas, or hydro-electric power. Exhibit VII-9 shows a number of specific industries that are particularly large users of fuel and power. In each of these the cost of fuel and power was at least five percent of the value of the product, considerably above the average for all industries.

Key Location Factors

In estimating how efficiently a given industry may be able to operate in an area, and therefore the degree of economic benefit that it may bring to the area, all the cost factors from the raw materials to the completed and delivered product have to be taken into account. We have noted that the importance of the different kinds of costs varies considerably from one industry to another. Therefore, an area that has certain assets which are highly significant to one group of industries may find itself at a disadvantage with respect to other types of industries.

Some idea of the variation in the importance of different kinds of costs from industry to industry may be had by studying Exhibit VII-10, though the information is based on incomplete coverage of firms and reflects particularly the experience of large companies. Direct materials cost is the largest expense item in many industries. In others, for example in the manufacture of gray-iron and malleable-iron castings, silverware, hats, electrical machinery, and hardware, the expense of wages and salaries in the production departments is almost as great as that for raw materials or even greater. Some industries, such as office and store machines, drugs and medicines, and perfumes and cosmetics, show exceptionally high selling expenses. The selling expenses reported in this table generally show only a portion of the costs of distributing the products. Many transportation and handling expenses are covered by the mark-ups of wholesalers and retailers. They do not appear in the factory costs. Yet, if a factory is to be competitive, it must be so located that these distribution costs for its output are not excessive by comparison with those of other factories.

Exhibit VII-9

INDUSTRIES IN WHICH FUEL AND PURCHASED ENERGY COSTS EXCEEDED FIVE PERCENT OF PRODUCT VALUE, UNITED STATES, 1937

Industries	Fuel and Purchased Energy Costs as Percent of Value of Product
Coke oven products*	68.4
Blast furnace products	26.4
Bone black, carbon black, and lampblack**	24.4
Cement	18.7
Lime	17.3
Ice, manufactured	15.6
Clay products, other than pottery	15.2
Nonclay refractories	9.8
Salt	7.8
Pulp (wood and other fiber)	7.8
Smelting and refining, zinc	7.5
Sand-lime brick	7.5
Wallboard and plaster (except gypsum)	7.2
Glass	6.9
Minerals and earths, ground or otherwise treated	6.7
Chemicals, not elsewhere classified	6.7
Dyeing and finishing, rayon and silk fabrics	6.6
Woolen and worsted, dyeing and finishing	6.6
Paper	6.2
Foundry products	6.1
Compressed and liquefied gases	6.1
Steel-works and rolling mill products	5.7
Gypsum products	5.6
Cast-iron pipe and fittings	5.2
Iron and steel forgings	5.1
Pottery, including porcelain ware	5.1

* Cost of fuel includes cost of coal used as a material.

** Cost of fuel includes cost of natural gas used as a material in the carbon black industry.

Source: National Resources Planning Board. Industrial Location and National Resources. December 1942., Washington: U. S. Government Printing Office, 1943, p. 161.

Exhibit VII-10

RATIO OF VARIOUS COSTS TO TOTAL COSTS IN SELECTED INDUSTRIES, UNITED STATES, 1939
(Industries listed in order of direct materials costs)

Industries	Production Costs (Percent)			Trading and Administrative Costs (Percent)		
	Materials Cost—Direct	Wages and Salaries	Other Production Expenses	Finished Goods Purchased for Resale	Selling and Advertising Expenses	General Office and Other Expenses
Cane-sugar refining	70.4	4.4	5.8	2.2	2.1	15.1
Flour and other grain-mill products	68.9	5.0	3.1	5.5	11.5	6.0
Tin cans and other tinware	66.1	14.1	5.4	.6	3.9	9.9
Milk and milk products	65.2	5.3	8.4	1.5	11.0	8.6
Leather—tanned, curried, and finished	64.4	16.3	10.8	.1	3.8	4.6
Cereal preparations and rice cleaning and polishing	61.2	3.6	8.5	0	18.3	8.4
Fertilizers	60.5	10.6	8.3	2.2	7.9	10.5
Motor vehicles, etc.	59.2	19.5	5.5	.3	5.8	9.7

Exhibit VII-10 (Continued)

Industries	Production Costs (Percent)			Trading and Administrative Costs (Percent)		
	Materials Cost—Direct	Wages and Salaries	Other Production Expenses	Finished Goods Purchased for Resale	Selling and Advertising Expenses	General Office and Other Expenses
Paints, varnishes and lacquers	58.1	7.0	7.1	.8	17.4	9.6
Primary smelting and refining, lead and zinc	57.9	14.6	5.3	5.7	4.3	12.2
Matches	55.4	14.9	7.1	.4	13.7	8.5
Dyeing and finishing cotton, rayon, silk, and linen textiles	55.0	22.3	10.1	1.6	3.6	7.4
Woolen and worsted manufactures	54.6	21.8	12.6	1/	4.3	6.7
Corn syrup, corn sugar, corn oil, and starch	52.6	9.7	14.2	1.4	9.9	12.2
Silk manufactures	52.3	23.5	8.3	0.7	6.4	8.8

1/ Less than 0.05 percent.

Exhibit VII-10 (Continued)

Industries	Production Costs (Percent)			Trading and Administrative Costs (Percent)		
	Materials Cost—Direct	Wages and Salaries	Other Production Expenses	Finished Goods Purchased for Resale	Selling and Advertising Expenses	General Office and Other Expenses
Food specialties	46.8	7.6	10.2	5.3	20.9	9.2
Aircraft and parts, including aircraft engines	44.0	25.9	12.8	3.0	2.5	11.8
Agricultural machinery including tractors	43.2	22.1	7.5	2.6	13.7	10.9
Railroad equipment	42.8	19.0	12.3	2.0	3.7	20.2
Steam engines, turbines, water wheels, and internal combustion engines	41.1	26.1	8.7	.2	11.7	12.2
Gypsum and asbestos products and roof coating (except paint)	41.0	19.3	9.0	4.1	15.1	11.5
Furniture	40.3	22.1	12.8	1.9	13.2	9.7
Steel works and rolling mills	40.2	27.8	13.0	4.0	3.3	11.7

Exhibit VII-10 (Continued)

Industries	Production Costs (Percent)			Trading and Administrative Costs (Percent)		
	Materials Cost—Direct	Wages and Salaries	Other Production Expenses	Finished Goods Purchased for Resale	Selling and Advertising Expenses	General Office and Other Expenses
Nonalcoholic beverages	40.1	4.6	5.2	4.3	31.5	14.3
Carpets and rugs, wool (other than rag)	39.5	26.6	14.4	1.2	7.7	10.6
Knit goods	38.8	31.2	4.9	7.1	9.9	8.1
Bread and bakery products	38.7	13.8	8.2	1.9	28.8	8.6
Rubber products	38.2	18.6	3.8	6.8	19.9	12.7
Construction and similar machinery (except mining and oil-field machinery and tools)	37.9	22.4	8.6	5.5	15.4	10.2
Men's and boys' tailored clothing	37.8	28.0	5.0	2.3	19.7	7.2
Bolts, nuts, washers, and rivets—made in plants not operated in connection with rolling mills	37.5	30.3	12.2	1.8	6.6	11.6

Exhibit VII-10 (Continued)

Industries	Production Costs (Percent)			Trading and Administrative Costs (Percent)		
	Materials Cost—Direct	Wages and Salaries	Other Production Expenses	Finished Goods Purchased for Resale	Selling and Advertising Expenses	General Office and Other Expenses
Refrigeration machinery and equipment and complete air-conditioning units, including domestic refrigerators	36.7	20.6	9.5	9.7	14.8	8.7
Radios, radio tubes, and phonographs	36.4	18.0	22.7	2.9	9.3	10.7
Hats, felt and straw, except millinery	36.4	35.2	4.7	1.6	13.6	8.5
Machinery	35.5	17.9	11.3	12.7	11.9	10.7
Gray-iron semisteel, and malleable iron castings	35.3	29.7	15.9	.9	4.4	13.8
Chemicals	35.1	20.8	8.0	9.4	9.4	17.3
Pumping equipment and air compressors	34.7	21.5	9.5	8.5	15.9	9.9

Exhibit VII-10 (Continued)

Industries	Production Costs (Percent)			Trading and Administrative Costs (Percent)		
	Materials Cost—Direct	Wages and Salaries	Other Production Expenses	Finished Goods Purchased for Resale	Selling and Advertising Expenses	General Office and Other Expenses
Drugs and medicine (including drug grinding)	34.5	10.0	7.7	1.6	32.9	13.3
Machine tools	34.0	28.0	14.6	0	11.3	12.1
Primary smelting and refining copper	33.4	25.0	23.7	2.6	2.0	13.3
Footwear, except rubber	33.3	23.4	8.2	14.7	13.9	6.5
Flat glass and pressed or blown glassware	33.2	24.8	17.0	3.3	9.5	12.2
Firearms and ammunition	32.8	33.0	6.2	7	10.1	17.2
Perfumes, cosmetics, and other toilet preparations	31.6	5.9	6.4	3.2	34.7	18.2
Electrical machinery	29.9	32.0	5.2	5.6	13.0	14.3

Exhibit VII-10 (Continued)

Industries	Production Costs (Percent)			Trading and Administrative Costs (Percent)		
	Materials Cost—Direct	Wages and Salaries	Other Production Expenses	Finished Goods Purchased for Resale	Selling and Advertising Expenses	General Office and Other Expenses
Metal-tool and other metal-working machinery, accessories, metal-cutting and shaping tools, and machinists' precision tools	29.5	36.8	7.5	4.2	11.8	10.2
Silverware and plated ware	29.4	28.0	5.9	9.1	17.1	10.5
Oven coke and coke-oven by-products	29.3	23.2	9.1	15.9	6.8	15.7
Hardware	28.6	25.0	14.8	9.8	9.9	11.9
Heating and cooking apparatus (except electric)	28.2	21.9	10.0	11.5	17.5	10.9
Lumber and timber products	28.1	31.4	19.3	8.9	5.5	15.8
Cigars, cigarettes, chewing and smoking tobacco, and snuff	27.1	3.6	2.3	.2	8.4	58.4

Exhibit VII-10 (Continued)

Industries	Production Costs (Percent)			Trading and Administrative Costs (Percent)		
	Materials Cost—Direct	Wages and Salaries	Other Production Expenses	Finished Goods Purchased for Resale	Selling and Advertising Expenses	General Office and Other Expenses
Textile machinery and sewing machines, domestic and industrial	26.0	16.4	5.5	5.8	36.7	9.6
Cement	26.0	19.7	17.2	1.5	12.0	23.6
Vitreous-china plumbing fixtures, enameled-iron sanitary ware, and other plumbers supplies, except pipe	25.7	20.3	10.2	24.3	9.7	9.8
Printing and publishing books and periodicals	25.0	9.1	23.0	4.3	28.3	10.3
Saws, files, and tools, (except edge tools and machine tools)	22.9	28.4	20.7	1.5	13.0	13.5

Exhibit VII-10 (Continued)

Industries	Production Costs (Percent)			Trading and Administrative Costs (Percent)		
	Materials Cost—Direct	Wages and Salaries	Other Production Expenses	Finished Goods Purchased for Resale	Selling and Advertising Expenses	General Office and Other Expenses
Malt liquors	17.8	9.0	12.4	1/	15.3	45.5
Office and store machines	10.8	25.8	11.1	1.8	31.7	18.8

1/ Less than 0.05 percent.

Source: National Resources Planning Board. Industrial Location and National Resources, December, 1942. Washington: United States Government Printing Office 1943, p. 132. Based on Industrial Corporation Reports of the Federal Trade Commission.

Thus, in determining whether an area is a good location for a particular kind of industry one must take account of three sets of costs:

1. The cost of the materials, fuel, and power, delivered to the factory.

2. The cost of factory operations, among which wages and salaries, the interest and depreciation on invested capital, machinery and equipment costs, taxes and real estate charges, are items.

3. The costs of selling, transporting, storing, and servicing the product in the markets where it is principally bought.

Some industries are "materials-oriented," or else oriented toward fuel and power. In these the first set of costs listed above is particularly important. Perishability of materials, weight-losing, or other factors mentioned earlier make it necessary to locate near the source of supply in order to keep costs at a minimum. Other industries are "market-oriented." These are industries in which it is more costly to transport the product than the raw materials, or where it is necessary to adjust quickly to changes in market demands. Or there may be other reasons which make it economical to locate near an important market. Industries of the first type have been called "rooted" (to materials coming from extractive industries or from earlier stages of manufacture) and those of the second type "tied" (to consumer markets or to later stages of manufacture which constitute a market for the product). In between are a group of industries sometimes termed "mobile" or "footloose." They are less bound by the need to be near to materials or markets. They are relatively free to locate in areas offering low operating costs within the factory itself. Low factory operating costs may come from low labor costs (a matter of labor efficiency as well as wage rates) or from low costs for capital and equipment. In selecting candidate industries, it is important to seek those which are characteristically oriented toward the kinds of advantages that the developing area can offer.

In some industries transport costs or other factors give a certain degree of "natural protection" to local producers against competition of producers located some distance away. Such industries may be identified by the fact that they are characteristically found widely scattered, even in the highly industrialized countries, rather than geographically concentrated. Industries that show a tendency to wide scatter are also, of course, ones in

which the costs of production on a small scale are not too disadvantageous as compared with large-scale operations. The study of industrial location patterns may therefore provide additional clues which will help newly developing countries to make suitable choices.

Exhibit VII-11 groups a considerable number of industries according to their tendency to geographical scatter or geographical concentration. The tool of analysis used in making this grouping is the "coefficient of localization." This is a statistical device in which a numerical value is computed to show the tendency of a given industry to conform with or depart from the general distribution of manufacturing industry in the country. A localization coefficient of "0" would mean that the industry is distributed geographically exactly the same as the average of all manufacturing industries. An industry which is extremely highly concentrated in one or a few places would have a localization coefficient approaching "1." Concentration may result from different causes. It may result from the fact that there are very great advantages from large-scale production in the industry, in which case it is likely to be an unfavorable indication, so far as the selection of this industry for a newly developing economy is concerned. However, it may result from the fact that the industry locates near raw material sources and that its required raw materials are found only in a few places, or at any rate more cheaply there. Such a circumstance could be highly favorable to an area that possesses the necessary materials.

Industry Characteristics Suited to Needs of Newly Developing Areas

Exhibit VII-12 is a general summary of results obtained by Kenneth A. Bohr in the study to which we have referred earlier. He investigated the characteristics of a number of different industries, making use of pertinent data from several industrially developed countries, and rated the industries on five characteristics. These were chosen as partial indexes of the suitability of the industries for conditions usually found in newly developing countries.

A rating of "1" in any column means that the industry, with respect to the characteristic dealt with in that column, is judged to be relatively well suited to less-developed areas. Thus, in the first column a rating of 1 signifies a low requirement for fixed capital investment. Where capital is scarce and expensive this is a desirable characteristic.

In the second column a rating of 1 means a low proportion of machinery and equipment costs in relation to the total fixed investment. In other words, more of the capital goes into land and

Exhibit VII-11

INDUSTRIES GROUPED BY THEIR TENDENCY TO GEOGRAPHICAL SCATTER OR CONCENTRATION, UNITED STATES, 1939

Scattered Industries (localization coefficient .14--.33)

Bread, etc.	.14
Paper containers, not elsewhere classified	.18
Biscuits and crackers	.19
Industrial machinery	.20
Newspapers	.20
Concrete products	.22
Machine shop products	.23
Nonalcoholic beverages	.25
Nonferrous metal foundries	.25
Gray-iron, semisteel castings	.26
Converted paper products	.27
Fabricated structural steel	.27
Malt liquors	.27
Sheet metal work not elsewhere classified	.27
Candy and confectionery	.28
Mattresses and springs	.28
Paper and paperboard mills	.28
Brick and hollow tile	.29
Paints, varnishes, lacquers	.29
Drug and medicines	.31
Mirrors and other glass products	.31
Fabricated plastics	.32
Tools (exc. edged tools)	.32
Prepared feeds, for animals	.32
Pumping equipment	.32
Stamped and pressed metal	.33
Trousers, (semidress)	.33
Wire drawn from purchased rods	.33

Moderately scattered Industries (localization coefficient .34--.42)

Chemicals, not elsewhere classified	.34
Household furniture	.34
Bookbinding	.35
Metalworking machinery	.35
Power boilers	.35
Work clothing	.35
Generating, distributing, and industrial appliances	.36

Exhibit VII-11 (Continued)

Moderately scattered Industries (localization coefficient .34—.42 (Continued)

Leather, tanned and curried	.36
Men's neckwear	.36
Wood products, not elsewhere classified	.36
Cordage and twine	.37
Knitted garments	.37
Lithographing	.37
Men's and boys' shirts	.37
Men's and boys' suits	.37
Stoves, ranges, and water heaters	.37
Food-products machinery	.38
Forgings, iron and steel	.38
Rubber products	.38
Wiring devices and supplies	.38
Malleable iron castings	.39
Women's outerwear (except wool)	.39
Bolts, nuts, washers, etc.	.40
Lighting fixtures	.40
Soap and glycerin	.40
Tin cans and other tinware	.40
Textile Bags	.41
Wooden boxes (except cigar boxes)	.41
Car and car equipment	.42
Leather goods	.42
Planing mill products, not elsewhere classified	.42
Radios, tubes, phonographs	.42
Steel castings	.42

Moderately concentrated Industries (localization coefficient .43—.55)

Batteries	.43
Alloying (except aluminum)	.44
Footwear	.44
Pickled, canned, and dried fruits and vegetables	.44
Internal-combustion machinery	.45
Machine tool accessories	.45
Meat packing	.45
Mechanical power transmission equipment	.45
Office furniture	.45

Exhibit VII-11 (Continued)

Moderately concentrated Industries (localization coefficient .43—.55) (Continued)

Steam fittings	.45
Hardware, not elsewhere classified	.46
Shipbuilding and repairing	.46
Glass tableware and containers	.47
Cutlery and edged tools	.48
Flour, etc.	.48
Knitted cloth	.48
Perfumes and cosmetics	.48
Screw machine products	.48
Women's and children's cotton underwear	.48
Blast furnace products	.49
Electric lamps, electric applicances, and other products, not elsewhere classified	.49
Silk throwing, spinning yarn, and thread	.49
Curtains and draperies	.50
Dyeing and finishing	.51
Jewelry	.51
Machine tools	.51
Refrigerators	.51
Steel works and rolling mills	.51
Women's and children's silk underwear	.51
Wood preserving	.51
Automotive electric equipment	.52
Construction machinery	.52
Corsets and allied garments	.52
Hosiery, full-fashioned	.52
Women's coats and suits	.54
Woolen and worsted fabrics	.54
Cigars and cigarettes	.55
Petroleum refining	.55
Trimmings	.55

Concentrated Industries (localization coefficient .57—.83)

Fertilizers	.57
Aircraft parts	.58
Pulp mills	.58
Agricultural machinery (exc. tractors)	.59
Creamery butter	.59
Office and store machinery	.59

Exhibit VII-11 (Continued)

Concentrated Industries (localization coefficient .57--.83) (Continued)

Rayon fabrics	.59
Boot and shoe cut stock	.60
Children's dresses	.60
Clay refractories	.60
Hosiery-seamless	.61
Motor vehicles and bodies	.62
Clocks, watches, etc.	.63
Embroideries	.63
Sawmills	.65
Silk fabrics	.65
Rayon throwing, spinning yarn, and thread	.66
Textile machinery	.66
Furs and fur goods	.67
Poultry, dressing	.68
Cotton fabrics	.70
Logging camps and logging contractors	.72
Cotton thread and yarn	.73
Beet sugar	.74
Oil-field machinery	.74
Cottonseed oil, cake, etc.	.81
Canned fish	.83

Source: Adapted from National Resources Planning Board. Industrial Location and National Resources. December 1942. Washington: U. S. Government Printing Office, 1943. Table 2, pp. 108-18.

Exhibit VII-12

RANKINGS OF SELECTED INDUSTRIES IN CHARACTERISTICS THAT BEAR ON THEIR SUITABILITY FOR NEWLY DEVELOPING AREAS

Numbers in each column refer to rankings in the characteristic stated at the head of that column. The lower the number the lower the requirements, the more scattered the locational pattern, or the smaller the size.

Industries	Total Fixed Capital Requirements	Machinery and Equipment Requirements	Skilled Labor Requirements	Degree of Localization	Prevalent Size
Boots and shoes	1	3	1	3	none
Soap and candles	1	1	3	2	none
Cooperage	1	2	3	2	2
Leather goods	1	1	1	2	2
Bedding and mattresses	1	1	4	1	1
Jewelry	1	1	4	4	2
Tailoring and ready-made clothing	1	1	4	2	none
Paints and varnishes	1	2	2	1	2
Hosiery	1	2	1	3-4	none
Knitted garments	1	2	1	2	none
Rubber goods and tires	1-2	3	2	2	5
Brooms and brushes	1	2	1	2	1
Glass (other than bottles)	1	1	3	1	none
Shirts, collars, and underclothing	1	1	1	2	3
Electrical machinery, cables and apparatus	2-1	2	4	3	5
Tanning	2	2	1	2	2

Exhibit VII-12 (Continued)

Industries	Total Fixed Capital Requirements	Machinery and Equipment Requirements	Skilled Labor Requirements	Degree of Localization	Prevalent Size
Cardboard boxes	2	2	2	1	2
Wood textiles	2-3	3	2	3	3
Furniture	2	1	4	2	1
Sawmills	2	4	3	4(R.M.)	1
Planing mills, wood turning, etc.	2	1	3	2	1
Sheet metal work	2	3	3	1	1
Nonferrous foundries	2	3	4	1	none
Millinery	2	1	1	2	1
Marble, slate, etc.	2	3	4	3(R.M.)	1
Cutlery and small hand tools	2	3	3	3	none
Fabricated plastics	2	1	3	1	none
Steelworks and rolling mills	2-4	4	4	3	5
Steel wire and products	2	2	3	1	none
Stoves, ovens, ranges	2	4	3	2	none
Agricultural machinery and implements	2-3	3	4	4	none
Iron foundries	3	2	3	1	none
Textile dyeing and finishing, etc.	3	3	2	3	none
Earthenware, china, etc.	3	2	1	4	3
Canning, jam, fruit, vegetables	3-2	3	2	3(R.M.)	2
Tobacco	3-1	2	1	3	4

Exhibit VII-12 (Continued)

Industries	Total Fixed Capital Requirements	Machinery and Equipment Requirements	Skilled Labor Requirements	Degree of Localization	Prevalent Size
Printing, general	3-2	2	4	1-2	none
Cordage and twine	3	3	2	2	none
Breweries	3-2	3	1	1	none
Motor vehicle repairs	3	1	4	1	1
Cement products	3	4	3	1	1
Newspapers and periodicals	3-2	2	4	1	2
Cotton textiles	4	4	2	4	3
Meat packing	4-3	2	2	3(R.M.)	none
Fish curing	4	2	1	4(R.M.)	1
Shipbuilding	4-1	3	4	3	4
Cement	4	4	3	1	3
Vegetable oil	4	4	2	4(R.M.)	1
Chemical fertilizers	4	4	1	4	none
Petroleum refining	4	4	4	4	4
Tire retreading and repairing	4	1	2	1	1
Synthetic textiles (rayon, nylon, etc.)	4	4	3	4	5
Glass bottles	4	4	3	3	none
Condensed and dried milk	4-3	4	1	4(R.M.)	1
Bricks and tile	4	4	2	1	2
Nonferrous rolling, etc.	4-2	4	4	2	none
Bakeries	4-1	1	1	1	1-2
Papermaking	4-3	4	3	1	3

Exhibit VII-12 (Continued)

Industries	Total Fixed Capital Requirements	Machinery and Equipment Requirements	Skilled Labor Requirements	Degree of Localization	Prevalent Size
Dehydrated fruit and vegetables	4	3	2	3(R.M.)	2
Industrial chemicals	4	4	4	2	4
Flour milling	4-2	3	4	3	1
Butter	4	3	1	4(R.M.)	1

Source: Bohr, Kenneth A. "Investment Criteria for Manufacturing Industries in Underdeveloped Countries." The Review of Economics and Statistics, May, 1954, p. 159. The rankings were made by Bohr on the basis of the following data:

Capital Requirements--Ratios of value of fixed capital to value added by manufacture, Australia, 1946-47. Where there are two figures the second refers to U. S., 1939.

Machinery and Equipment Requirements. Ratios of value of machinery and equipment to total value of fixed capital. Australia, 1946-47.

Skilled Labor Requirements. Ratio of professional persons, foremen and skilled workers to total employees. U. S., 1930.

Localization Coefficient. Geographical distribution as measured by employment. U. S., 1939. The symbol (R.M.) indicates that the industry tends to locate close to sources of raw materials.

Prevalent Size. Size of median firm in cases where distribution of employment by firm size shows a regular distribution. Great Britain, 1930, and U. S., 1929. In cases where size classification differed between the two countries the most favorable (the smallest) has been used. "None" means there is no prevalent size.

buildings and less into items such as machines that would probably have to be purchased with foreign currencies. This is a desirable characteristic where balance of payment difficulties may be encountered.

In column three a rating of 1 is given for a relatively low proportion of professional, supervisory, and skilled workers to total workers. Such industries face fewer obstacles and bottlenecks occasioned by the scarcity of trained manpower in the initial stages of industrialization.

In column four the rating of 1 stands for a tendency to a wide geographical scatter of plants in the industry, while ratings of 2, 3, and 4 denote progressively greater geographical concentration. For reasons mentioned previously, the industries that typically have a wide scatter are likely to be easier to establish in newly developing areas. However, as was also mentioned, there are cases where a high degree of geographical concentration results from the tendency of an industry to locate near concentrated raw materials. For countries having good sources of the required raw materials this would be an advantage rather than a disadvantage. Such industries are indicated by the symbol "R. M."

In the last column to the right, the figure 1 indicates a relatively small prevailing size of plant. Since the markets in newly developing countries are small in terms of effective demand for manufactured products, and since there are social as well as economic obstacles to assembling large aggregations of capital and establishing large plants, this characteristic of small size is likewise favorable for industries to be considered by such countries.

It is apparent that data assembled in this chapter in order to compare the economic characteristics of various industries and to suggest their suitability or unsuitability for developing countries are very uneven in quality. Often the information available fails to get at the points in which we are really interested. Much of it is out of date. It relates almost exclusively to highly developed countries where statistics are more readily available and where more industrial studies have been made. The careful study of the technical and economic characteristics of a wide range of industries, with a view to producing information that would make for more intelligent industrial programming in newly developing countries, is still an "underdeveloped area" in research.

REFERENCES, CHAPTER VII

1. Brown, A. J. Industrialization and Trade: The Changing World Pattern and the Position of Britain. London: Royal Institute of International Affairs and Oxford University Press, 1943. P. 29.

2. Alderfer, E. B., and H. E. Michl. Economics of American Industry. 2d. ed. New York: McGraw-Hill Book Company, 1950.

Allen, Edward L. Economics of American Manufacturing. New York: Henry Holt and Company, 1952.

Glover, John George, and William Bouck Cornell. The Development of American Industries: Their Economic Significance. 3d. ed. New York: Prentice-Hall, 1951.

Hanson, Simon G. Economic Development in Latin America. Chapter VI. Washington: Inter-American Affairs Press, 1951.

Hoover, Edgar M. The Location of Economic Activity. New York: McGraw-Hill Book Company, 1948.

Hughlett, Lloyd J., ed. Industrialization of Latin America. New York: McGraw-Hill, 1946.

McLaughlin, Glenn E., and Stefan Robock. Why Industry Moves South: A Study of Factors Influencing the Recent Location of Manufacturing Plants in the South. National Planning Association (Washington, D. C.), Committee of the South, Report No. 3, June 1949.

National Resources Planning Board. Industrial Location and National Resources. December 1942. Washington: U. S. Government Printing Office, 1943.

U. S. Department of Commerce, Office of Domestic Commerce, Area Development Division. Basic Industrial Location Factors: A Guide for Evaluating an Area's Resources for Industrial Development. Industrial Series No. 74, revised June 1947.

Wythe, George. Industry in Latin America. 2d. ed. New York: Columbia University Press, 1949.

3. To date the series of industry brochures which the Foreign Operations Administration has had prepared includes:

Requirements for Planning a Gray-Iron Foundry.

Requirements for a Plant to Manufacture Toilet and Laundry Soap.

Requirements for a Plant to Manufacture Cooking Utensils.

Requirements for Planning a Small Underwear Mill.

Requirements for a Plant to Manufacture Pump and Windmill Head Units.

Requirements for a Small Finished Lumber Manufacturing Plant and Training School.

Requirements for a Plant to Can and Dehydrate Food Products.

Requirements for a Plant to Manufacture Wood Tables and Chairs.

4. United Nations, Economic and Social Council, Economic Commission for Latin America. Study on Iron and Steel Industry and Report on Meeting of Experts Held in Bogota and Sponsored by the Economic Commission for Latin America and Technical Assistance Administration. E/CN. 12/293. February 1953. Vol. I, pp. 16-20. See also Preliminary Study of the Technique of Programming Economic Development. E/CN. 12/292. 15, March 1953. Chart B, p. 103.

5. Labour Productivity of the Cotton Textile Industry in Five Latin-American Countries. United Nations, Department of Economic Affairs, New York, 1951, p. 6.

6. Hoover, Edgar M. The Location of Economic Activity. New York: McGraw-Hill Book Company, 1948, p. 71.

7. Labour Productivity of the Cotton Textile Industry in Five Latin-American Countries, p. 52.

8. Bohr, Kenneth A. "Investment Criteria for Manufacturing Industries in Underdeveloped Countries." The Review of Economics and Statistics, May 1954, pp. 157-166.

9. National Resources Planning Board. Industrial Location and National Resources. December 1942. Washington: U. S. Government Printing Office, 1943. Chapter 6, "Materials," by Wilbert G. Fritz and Oscar L. Endler.

Part III

TESTING CANDIDATE INDUSTRIES

Chapter VIII

THE TEST OF NET RETURN

If the recommended procedures of Part II have been acted upon, a preliminary screening of industrial possibilities for the developing area has been carried through. A list of candidate industries (and industry groups) is in hand. Surveys have been made of the demand for manufactured goods in the area and in possible export markets. The industrial resources of the area have been appraised, also the possibility of importing special skills or equipment or capital from outside. Industries that have been considered, especially those finally selected as candidate industries, have been examined in a preliminary way for technical and economic characteristics which suggest that they might or might not be well suited to the circumstances of the area.

The next step is to make a more intensive study of each of the candidate industries, and of conditions in the area which affect the industry's chances of being successful and beneficial, if established. The methods to be used are those already outlined in the chapters on "Analyzing Demands," "Analyzing Resources," and "Matching Industries to Demands and Resources." But this time, the analysis is focused more specifically on a smaller range of industries and is more thorough for each industry. It will be assumed in what follows that this step has been completed.

Now, the problem is: How can a rational choice be made among the candidate industries? (Presumably, the list of candidate industries is long enough so that not all can be undertaken at once.) We need a guiding principle—a beacon by which to chart the course of industrial development. And we need a series of practical tests or criteria by which to rate Industries A, B, C, X, Y, and Z, so as to come out with a clear indication that B, C, and Y, for example, are excellent for the area, while A, X, and Z offer, on the whole, less promise of benefit at the present stage in the area's development.

The guiding principle to be recommended is the <u>principle of net return</u>, estimated on the basis of the increase which a candidate industry may be expected to bring, directly and indirectly, in the real national product of the area being developed. This principle will be explained below and will be contrasted with certain other principles that have been suggested or used for choosing industries, but which are unsatisfactory.

The practical tests to be recommended are the subject of the last part of this chapter and of six brief chapters that follow. The first test is a preliminary estimation of net return. It is recommended that net return be estimated initially by the methods which would be used by a business enterprise considering entry into the field of the candidate industry and that the estimate then be modified to take account of the differences between net return from the viewpoint of a business enterprise and net return from the viewpoint of the whole economy. The present chapter describes how to arrive at a first approximation of net return. Subsequent chapters present supplementary tests which are, in effect, modifications or refinements of this first approximation. They deal with "The Test of Integrated Development," "The Test of Stability and Growth," "The Test of Balance of Payments Effects," "The Test of Social Desirability," and "The Test of Experience." The final chapter suggests a procedure for combining the results of the different tests in such a way as to establish an order of preference among the candidate industries.

The Principle of Net Return

The amount by which an industry raises the real national product, we shall call the return from that industry.* The industry's contribution to the real national product is measured by subtracting from the value of what it produces the cost of the resources it uses. Therefore, we shall speak of net return.

An industry adds directly to the real national product by producing things of greater total value than the resources it uses up. It may also add indirectly to the real national product by helping to create conditions which make other industries, or other segments of the economy, more productive.

Net return from the national-product point of view is not entirely the same as net return from the business-enterprise point of view, though the two types of return do have important elements in common. It will often be true, but not always, that an industrial

---

* There are some differences between "real national product" as the term is used here and the usual statistical measures of national product, but it is not essential to go into these differences for present purposes.

project which offers substantial prospects of being profitable to the community at large will also offer substantial profit opportunities to private business. Where this is true, the development problem is to find ways to facilitate entry of private enterprise and capital into lines of activity that should attract private initiative in any case. Where there is a considerable discrepancy between prospective net return in the national-product sense and prospective net return in the business-enterprise sense, there may be a case either for special government aid (as in subsidizing an airline or imposing an import tariff) or for government discouragement (as in restrictive regulation of narcotics or special taxes on luxury goods). The differences between the national-product return and the business-enterprise return from an industrial project will be further discussed below, as will methods of estimating each.

This Manual recommends that the candidate industries to be selected for first development should be those which, on careful study of the direct and indirect contributions each might be expected to make to the real national product, promise the greatest net return in proportion to the resources (represented by invested capital) that would have to be devoted to them. This principle of net return is not only a sound guide to the questions: What new industries should be developed? and, Which industries should be developed first? It is also the correct principle on which to answer the further questions: Should an existing industry be expanded? How far should it be expanded? Is it more advantageous at the present time to build more units of Industry F, or to establish a first unit of Industry G? The general guide is: Choose first for inauguration or expansion those industries in which new manufacturing units promise the greatest net return, and continue to do so successively. As the economy grows, new industries will continue to be added or old ones expanded in a sequence always determined by estimates of net return.

The growth of markets as incomes rise, the development of more skilled workers and managers, the opening up of new natural resources and improvements in basic industrial facilities, such as transportation and education, will bring more and more industries into the position where they recommend themselves on the principle of net return.

CRITIQUE OF OTHER RULES

Certain other principles or rules of thumb have sometimes been put forward as guides to the selection of industries for a developing area. Sometimes they have been explicitly stated, and sometimes they have merely been implicit in recommendations or actions. All of them are less satisfactory than the principle of net return. Some are seriously misleading. Others embody important elements of truth but exaggerate one aspect of the problem at the expense of other aspects. All the elements of truth which they do contain are also contained in the principle of net return, and in better balance.

Retracing Principle

Sometimes it is said or implied that the right sequence for the development of industries in a newly developing area can be found by retracing the industrial history of Great Britain or some other early-comer to industrialism. Textiles had a prominent part in the rise of modern industry in Great Britain; therefore, this argument might run, other countries would do well to start with textiles.

There are many errors in this line of thinking. The knowledge of industrial technology on which newly industrializing countries can draw today is vastly greater than in an earlier day. Thousands of articles are made by factory methods now which could not be so made in 1800. The fact that the textile industry was the scene of some of the pathbreaking industrial inventions does not mean that the textile industry is the only place, or the easiest place, to embark on manufacturing nowadays. Nor does the fact that ironworking was the scene of other early industrial advances mean that this is necessarily the best line of manufacturing by which to enter the field of structural materials. Cement, aluminum, and plastics, all of which were unknown in the early days of industrialism, might be better candidates, depending on the needs and resources of the industrializing area, the terms on which it can get imports, and the internal and external markets available to it.

Not only is the choice of industrial opportunities vastly wider than when earlier countries industrialized, but also the demands of modern consumers and of industrial buyers of manufactured products are greatly different. Also, the competitive situation is very different. Most industrial products, especially the older, traditional ones, are readily available on the international market. Only a careful analysis of costs and market prospects can determine whether

it is more advantageous to a developing area to manufacture a particular product at home or to continue buying it from outside and to manufacture other things instead. The conclusion will surely be different from country to country. There is no reason to assume that the industries which were the pioneers in some other countries in former days will always come out ahead in such an analysis.

On the other hand, there may be certain characteristics of the pioneer industries of earlier times which still favor them as candidates in the early stages of industrialization today. The textile industry, for example, caters to one of the most widespread and steady demands. Some parts of it can be embarked upon with comparatively little capital, and can make use of large amounts of semiskilled labor. The ironworking industries do supply products needed by many other industries, and there is an advantage in having them close at hand, if this does not involve excessive costs. To the extent that these and other factors still favor the traditional pioneer industries, however, a correct analysis of prospective net returns will take account of them. Nothing is gained by loading the scales in favor of any industries simply because of their historical role in other areas.

Small-Scale Copy Principle

Some years ago a group of engineers drew up a comprehensive proposal for industrial development of a certain large but economically very underdeveloped country. In the introduction to their report, they compared the total output of that country, as it was and as they hoped it might become after a period of development, with the total output of the United States. They then suggested that the country would need to develop in the next stage of its industrial growth a certain fraction—let us say 1/100th—of the industrial capacity of the United States. Therefore, it was argued, the country would need sulfuric acid plants capable of producing about 1/100th of the sulfuric acid output of the United States; it would need a metalworking industry about 1/100th the size of that in the United States; and so on. Luckily, those who made this study were good practical engineers, though they were bad economic theorists, and quickly dropped the wholly untenable principle put forward in the introduction when they got into the concrete portions of their work.

The notion that a newly developing country should try to copy on a reduced scale the industrial structure of some more developed country is so fallacious that it must not be used even as a first approximation. There are at least four things wrong with it.

First, it neglects differences in market demands. Economically advanced countries with high income levels not only buy more goods than countries on low income levels, but they spend their money on different kinds of goods. Climate, cultural conditions, and other factors also make the demand for manufactured goods different in different countries.

Second, the copying idea neglects differences in industrial resources. Where one country may have a splendid endowment for manufactures based on agriculture (preserved meats, canned fruits, vegetables, etc.), another may lack good resources of this type but be well-endowed for the production and processing of certain minerals, or the pursuit of types of manufacturing that require large blocks of electric power.

Third, it neglects the differing effects of scale of operation on costs in different industries. It is one thing to suggest establishing a shoe industry on a scale representing a small fraction of the output of that industry in some industrially advanced country, and quite another to suggest doing the same with the automobile industry or the steel industry. Shoe plants can operate economically on a small scale, but automobile plants and steel plants are much less adaptable to small-scale operation.

Fourth, it neglects the advantages a country can get from international trade. A country may obtain some things at much less cost by importing them from other countries that have the appropriate resources. On the other hand, it may benefit considerably by expanding its own production of certain other things that it can export. The industrial structure that is most appropriate to one country in this respect is not necessarily the best for another, depending as it does on all the factors of markets, resources, and industry characteristics that we have previously discussed.

Basic Industry Principle

It is sometimes held that certain industries are "basic" to modern industrial development and that it is desirable or necessary to build them up ahead of other industries. Industries for which this argument is often advanced include iron and steel, other metalworking industries, and so-called heavy chemicals.

The very word "basic" is a question-begging word, likely to be confusing and misleading. It is often used quite loosely in books on industrial history and geography. What is a "basic" industry? Does it mean:

1. An industry which performs the early processes in a sequence of production processes? This would point to raw materials production and to industries that do the first processing of raw materials. Some industries of this sort are likely to be good candidates in a newly developing country, but determination of this point should depend on careful analysis of markets, resources, and relative costs, not on any preconceived ideas. Good candidate industries are also likely to be found at the very end of the production sequence. As we have previously noted, one of the best ways for a newly developing area to enter the manufacturing field may be to perform certain final stages of assembly, importing component parts, and then gradually to work back toward the manufacture of more and more complex components. This, too, should depend on analysis of markets, resources, and relative costs.

2. Or does basic industry mean an industry that makes a product without which many other industries would be gravely handicapped? In this sense, papermaking and toolmaking are among the most basic industries. It is the product of these industries that is essential, however, not the industries themselves. It may or may not be advantageous for a developing area to embark on papermaking and toolmaking depending on local resources, markets, and relative costs. Paper and tools can be imported, providing that the area develops exports so as to earn means of payment. Some items that are essential to the success of a wide range of industries do have to be produced locally, however, and this brings us back to the "Foundations of Industrial Development" discussed in Chapter III. Specifically, some "basic industries" for which imports cannot substitute are transportation, communication, marketing facilities, power, water supply, natural resources development, health services, education, and vocational training.

3. Or is a basic industry one that makes producers' goods, or capital goods, as distinguished from consumers' goods? Again, the products are essential, particularly to a rapidly developing country, but it may or may not be advantageous to undertake their local manufacture. Which ones can advantageously be made in the area will again depend on markets, resources, and relative costs. A factor to be weighed, of course, is the convenience and stimulus to other industries of having a local source of supply for common construction materials and items of industrial equipment. But account also has to be taken of the possible handicap to other industries if the local production turns out to be inefficient and forces local industries to pay excessive prices for poor quality materials and equipment.

It will almost surely not be advantageous in early stages of development to try to manufacture all the types of factory machinery,

locomotives, motor trucks, measuring instruments, oil drilling rigs, and so on that an area will need for its own development. Manufacture of capital goods is particularly likely to run against special obstacles in industrially less-developed areas, such as inadequate markets, shortage of capital, and shortage of the right kinds of skilled labor, supervision, and managerial experience. But there are some types of capital goods where local manufacture may be strongly favored by high transport costs, by availability of raw materials, by the standardized nature of the product, and by heavy demand in development projects. Examples are cement and fertilizers.

Related to the question of "basic" industries is the argument whether "heavy" or "light" industries should be favored in early stages of industrial development. Here, too, the terms are vague and apt to confuse rather than clarify the economic issues. In other words, this is not a very fruitful way to state the problem of industrial selection. "Heavy" industry as distinguished from "light" has been used by various writers to mean such related but different things as using heavy materials, producing heavy products, using large amounts of equipment of massive types, using a large amount of power as measured by horsepower per worker, producing capital goods, producing goods requiring a heavy total capital investment or requiring heavy capital investment per worker or per unit of output. None of the distinctions suggested by these various possible meanings of "heavy" vs. "light" is enough to determine whether an industry is or is not likely to be more advantageous than some other industry to a developing area. Insofar as any of these points deserve to be taken into account, and some are quite important, they will not be overlooked by an analysis guided by the principle of net return.

Political and military factors are probably the most important in giving currency to the view that "basic" or "heavy" industries should be developed first and that consumers' goods industries should be deliberately postponed. Such a policy is more suited to a country where:

1. The rulers do not consider an early and rapid rise in the living level of the people to be as important as building an industrial system designed to support military power, and they are able to force the people to accept the necessary hardships.

2. The country, by choice or by necessity, has to operate as a closed economy, unwilling or unable to trade extensively with other countries.

3. The geographic area for development is a very large one, with a great variety of resources and the potential ability to produce nearly all kinds of goods.

This roughly describes the Soviet Union, which is the outstanding example and advocate of the policy. For other countries, however, where there is more concern with advancement of the living level of the people, where there is willingness to trade extensively with other countries, and where the geographic area is not continental in size and variety of resources, the policy of developing first the "basic" or "heavy" industries is much less appropriate.

Single Factor Principles

In countries that are in the early stages of industrial development, unskilled labor is often relatively abundant and cheap (cheap not only in the sense that it can be hired at a low wage, but also in the sense that it is not very productive in its present occupations and, therefore, can be diverted to new activities without costing the economy much in reduced output of other products). Capital available for industrial investment in these countries, on the other hand, is generally scarce and expensive (in the sense that it demands a high return, and also in the sense that using capital for one purpose is at the cost of not having it for other important purposes which might also contribute substantially to the national product).

Therefore, economists often advise less-developed countries to choose "labor-intensive" industries and processes—that is, ones in which a large amount of labor is required in relation to the capital employed, or in relation to the value of the output. Similarly, such countries are advised to avoid "capital-intensive" industries and processes. Or, what comes to the same thing, industries with a high ratio of output-value to required capital investment are recommended.

There is a good deal of validity in these prescriptions. They can serve as useful rules of thumb in preliminary comparisons among industries not too dissimilar in other respects, if one remembers that they are not the whole story and can, at times, be definitely misleading. The trouble with them is that they suggest a conclusion on the basis of a single cost factor, where there are also other factors to be estimated.

It is a sensible rule to spread a scarce resource (capital) as far as possible and to substitute a more abundant resource (unskilled

labor) for it where this can bring equivalent results at less real cost. But this result does not always follow, and the rule breaks down. For example, everyone agrees that among the most essential and productive investments which newly developing countries should make is improvement of transport and communications—roads and motor trucks, railroads, airlines, telegraphs and telephones. Yet these are typically capital-intensive activities. Modern roads and motor trucks are so much more productive than wheelbarrows, porters, or other labor-intensive methods of transportation that it is good economy to spend scarce capital on equipment of this type instead of using abundant labor. Again, an automatic machine may save so much of the time and cost that would otherwise be required for training labor and providing supervision, and may turn out so much more product, that this relatively heavier use of capital is justified, even in a country where the cost of capital is high. Also, we must not forget that a part of the value produced by modern machinery when first introduced into an industrially less-developed country is in the training and upgrading of labor and management. This may at times justify more advanced equipment than would be economic in terms of immediate output alone.

The true test of whether it is more advantageous to introduce Industry A, which has a high ratio of capital to output, or Industry B, which uses relatively more labor and has a lower ratio of capital to output, is the total of all costs—capital costs, unskilled labor costs, skilled labor costs, supervision costs, raw materials costs, and other costs—in relation to the value of the output produced. In other words, we are back to the principle of net return. The net return principle gives due weight, but no more than due weight, to the relative costs of labor and capital and to relations between capital investment and value of output.(1)

ESTIMATING NET RETURN

We turn next to the practical problem of how to estimate the net return which each of the candidate industries or industry groups might be expected to yield if established in the developing area. Of course, a forecast of net return can never be more than a rough estimate resting on more or less speculative assumptions about the demand for the product, the cost of the resources, and other future circumstances. For our purposes, fortunately, a high degree of accuracy in the estimates is not essential, providing that inaccuracies

do not too seriously disturb the comparative rankings of the various candidate industries. What we really want to know is which candidate industries offer a prospect of relatively high net return and which a prospect of relatively low net return.

The first step in estimating net return is to make for each candidate industry the same calculations that a private business enterprise ought to make before deciding to establish a new manufacturing plant in this particular industry in the area. The result will be an estimate of the prospective profit or loss and, if a profit is foreseen, the likely rate of return on the capital invested in the enterprise.

The next step is to make a number of adjustments, to be explained below, to the income and cost estimates as they would look to a business enterprise, in order to express more accurately the prospective value of the undertaking from the point of view of the whole economy. The adjusted estimate represents net return from the national product viewpoint.

It is suggested that, after estimates of net return from the national product viewpoint have been prepared for all candidate industries (by the methods to be outlined in the following pages) the candidate industries should be ranked according to their performance on this basic test. The industry which offers the greatest net return to the economy in proportion to the investment which would be made in it is ranked at the top of the list. The next most promising is placed second, and so on. These rankings will later be modified to take account of the results of supplementary tests that will be outlined in subsequent chapters.

Net Return to the Enterprise[2]

We are interested in prospective net return after the new manufacturing enterprise has had a chance to "shake down" and establish itself as a going concern. Therefore, calculations should be based on an assumed "normal" year's operation, not the first year in most cases, and in some cases, not even the second year. However, any anticipated special expenses and losses in the initial period of operations must be reckoned as part of the capital investment required to get the manufacturing enterprise under way.

From the market studies that have been made, an estimate must be prepared of the number of units of the product which can probably be sold in a normal year, and of the price at which they can be sold, on the average. The number of units multiplied by the price per unit gives the estimated gross sales. From this should be subtracted the probable cost of selling and advertising, and any shipping costs that will have to be paid by the factory.

A manufacturing plan must be made. The appropriate yearly output (taking into account marketing possibilities and any special limitations that may be imposed by the supply of materials or other factors), the number of days the factory is expected to operate per year, and the production capacity per day must be estimated. A flow sheet should be set up, showing the progress of the materials from one working post or machine to another in the factory, and an estimate must be made of all equipment, buildings, materials, supplies, and personnel required in order to maintain the planned rate of production. The approximate cost of all these items must be estimated.

A summary should now be prepared of the estimated manufacturing cost. Exhibit VIII-1 suggests a form in which such a summary can conveniently be arranged and shows the principal items to be considered. If more than one product is to be manufactured in the same plant, then the direct labor and materials costs of each product should be calculated separately and the overhead should be divided among them in computing unit costs.

Finally, a projected profit and loss statement should be drawn up and the prospective rate of return on invested capital should be calculated. A convenient form and the principal items to be considered are shown in Exhibit VIII-2. In figuring the required capital investment and the expected rate of return on the investment, care must be taken to make a substantial enough allowance for working capital. Experience shows that the managers of small manufacturing plants, and especially newcomers to the field, often underestimate the working capital that is needed.

Net Return to the Economy

If prices and costs are determined in a market that is not too heavily influenced by various kinds of monopoly power or governmental interventions, it will be broadly and roughly true that a manufacturing enterprise which assembles resources at a certain cost and converts them into finished products which sell for more

than that cost will be increasing the real national product and the real income of the people. If the resources it uses up cost more than the value of its output, then it is likely to be wasting resources and decreasing the real national product and income. This is true because the price at which a manufactured product sells in a free market gives a rough indication of its real value to the people who buy it and hence to the community; while the prices paid for materials, the wages paid for labor, the interest and depreciation which enter into the cost of capital, and other expenses of a manufacturing enterprise, give a rough indication of the real cost to the community of the various resources that are being used up in order to make the manufactured product.

It needs to be emphasized, however, that market prices and costs, which a manufacturing firm uses in its accounts, are only rough indicators of the real value to the economy of the output the firm produces and the real cost to the economy of the resources it uses. They are by no means perfect indicators. The reasons are many, and it would not be particularly pertinent to discuss them here. But we must note some of the possible discrepancies and try to make corrections for them when attempting to compare the real value of different candidate industries to the developing area.

Three types of adjustments have to be made in order to pass from calculations of net return made for an individual manufacturing enterprise to calculations of net return for the economy as a whole. These adjustments relate to:

1. The value of the output
2. The cost of the resources
3. The indirect benefits and costs of the industry

Value of the output. From the viewpoint of the manufacturing enterprise, the value of the factory's output is determined by the price at which the product can be sold. If the product is shoes which can be sold to distributors at $7.50 a pair, the value to the factory enterprise of each pair produced and marketed is $7.50. But suppose that shoes of the same type and quality are available from abroad at $5.00 a pair, including all freight and handling charges to the point where the shoes are taken over by local distributors. In this case, from the national-product point of view, locally produced shoes are really "worth" only $5.00, since $5.00 is all the country would have to give up to get equally good ones. If there is an import tariff or some arrangement of import quotas or

Exhibit VIII-1

FORM FOR ESTIMATING MANUFACTURING COST

Assume: production of _____ units by plant operating _____ hours during a "normal" year.

1. Direct Labor Cost:

_____ workers of classification A for _____ hours at _____ per hour = _____

_____ workers of classification B for _____ hours at _____ per hour = _____

etc.

Total direct labor cost for year

2. Raw Materials Used in Production:

_____ units of commodity A at _____ per unit = _____

_____ units of commodity B at _____ per unit = _____

etc.

Total raw materials cost for year _

Exhibit VIII-1 (Continued)

3. Overhead:

Administration (administrative and clerical salaries, other office expenses)--total for year	_____	
Depreciation of plant and equipment (purchase cost of buildings ÷ estimated life, plus purchase cost of each item of equipment ÷ estimated life)--total	_____	
Rent (for buildings, machinery, and equipment on an annual basis)	_____	
Power, light, and other utilities--total for year	_____	
Supplies (all purchases other than raw materials used in production)--total for year	_____	
Insurance costs, for year	_____	
Indirect labor (supervision, maintenance and repair, inspection, etc.)--total for year	_____	
Taxes (other than income taxes), for year	_____	
Interest on borrowed funds for year	_____	
Other expenses for year	_____	
Total overhead for year		_____

Total Manufacturing Cost (sum of 1, 2, 3) _____

Number of units of product (estimated output for year) _____

Unit Cost (total manfacturing cost ÷ number of units of product) _____

Exhibit VIII-2

FORM FOR ESTIMATING PROFIT AND LOSS, CAPITAL REQUIRED, AND RETURN ON INVESTMENT

Profit and Loss

1. Estimated gross sales for year _____

2. Selling costs, returns and allowances, discounts allowed _____

3. Net sales (1 minus 2) _____

4. Cost of goods sold (total manufacturing cost, sum of items 1, 2, 3 in Exhibit VIII-1) _____

5. Estimated profit or loss (3 minus 4) _____

Capital Required

6. Fixed capital (buildings, land, equipment) _____

7. Working capital (revolving fund necessary to meet operating requirements such as payrolls and materials, pending receipts from sales) _____

8. Reserve for contingencies _____

9. Total capital needed (sum of 6, 7, 8) _____

10. Amount expected to be covered by bank loans or other borrowing (for which interest expense was charged in "Overhead," Exhibit VIII-1) _____

11. Estimated requirement for proprietary investment--"equity" capital (9 minus 10) _____

Return on Investment

12. Estimated profit (item 5) ÷ estimated proprietary investment (item 11) = _____ percent, estimated return on investment

controls the local manufacturer may still be able to sell his shoes at $7.50, but the $2.50 is, in effect, a subsidy paid to the local enterprise by local consumers.

In estimating the benefit which the economy as a whole will derive from any candidate industry, the value of the product of that industry should be figured at a price no higher than the price at which an equivalent product could be obtained by other means. That is, the value is no greater than the imported cost, in the absence of all tariffs or trade restrictions imposed by the importing country. Also, if the price to be received by local manufacturers includes any direct subsidy, the amount of the subsidy must be deducted in figuring the national-product value of the output.

Cost of the resources. A manufacturing enterprise reckons its costs on the basis of the going prices that it must pay for borrowed capital, raw materials, wages and salaries of personnel, and so on. But these may not always reflect the "true value" to the community at large of the resources being used. In estimating the worthwhileness of a particular candidate industry from the national-product point of view adjustments both upward and downward may have to be made in the cost calculations that a business enterprise would make.

Where an import tariff affects the price of a raw material needed by a candidate industry, an adjustment must be made. The true cost to the economy is the landed and delivered cost of the material without any import tax. Note that this adjustment has the effect of raising the estimated net return in the candidate industry from the national-product viewpoint as compared with the enterprise viewpoint. The adjustment for tariffs on finished products previously described had the opposite effect.

Where the resources to be drawn upon by a candidate industry would otherwise by underutilized, the real cost to the community of devoting these resources to the proposed industry may be less than the price which the factory would pay for them. For example, this may be true where the factory will use the off-peak capacity of a hydroelectric power installation, (unless it gets the off-peak power at lower prices which fully reflect the lower cost of such power). Another common case is the use of labor that would otherwise not be productively employed. In densely populated countries where many people are crowded on the land, it has often been observed that a substantial fraction of the agricultural workers add practically nothing to the national product. That is, these

workers could be removed and those left behind would be able to turn out about the same total output. But these excess workers have to be fed even when they are producing little or nothing. In such circumstances, the national-product cost of withdrawing labor from agriculture and putting it to work in factories may be almost nil—perhaps only the increased consumption which the transferred workers and their families might now be able to afford. In an area where this situation prevails, a candidate industry that would utilize such labor should have its labor cost figured at a lower rate, from the national-product point of view, than the actual wage rates which would represent the cost from the point of view of a business enterprise.

From the business-enterprise viewpoint, interest on borrowed capital is figured among the costs. The profitability of the enterprise is reckoned in terms of the percentage of return on the "proprietary" or "equity" investment. From the national-product point of view, it is preferable to figure the rate of return on the basis of the total amount of capital that has to be invested in the candidate industry, for this represents the real capital resources that are being channeled into the industry from the economy. Whether the investment takes the form of equity capital or loan capital makes no difference from this viewpoint. Therefore, interest on loan capital, which was shown as one of the cost items in Exhibit VIII-1, is not counted as a cost when figuring the net return from the national-product point of view; instead, loan capital and equity capital are combined in the total investment on which the percentage rate of return is computed.

Indirect benefits and costs of the industry. Finally, account must be taken from the viewpoint of the economy as a whole of certain indirect benefits and costs to be expected of candidate industries. Most of these indirect benefits and costs cannot be calculated precisely. (Indeed, the entire procedure of estimating, even when putting down income and cost figures that have the appearance of precision, is really only informed guessing about the future.) The best one can do is to study the facts about each candidate industry with respect to these indirect benefits and costs, making note of relevant plus-values or minus-values to be weighed in the mind along with the other things that have been learned about the industry.

First, an industry may, in addition to producing a valuable output of its own, help to make it easier to start other industries. Or it may enhance the productivity of existing industries and of

other segments of the economy, such as agriculture. These indirect benefits will be considered further in Chapter IX.

Second, some manufacturing industries are highly seasonal, others fluctuate violently with the ups and downs of the business cycle or special market conditions, while others are more stable. Some appear to have better long-range growth prospects than others. Plus or minus values of this sort will be dealt with further in Chapter X.

Third, some industries produce for export and earn foreign currencies, or produce locally goods which would otherwise have to be imported and paid for in foreign currencies. Where the area has difficulty keeping its balance of payments in equilibrium, such industries offer important indirect benefits. This is discussed in Chapter XI.

Fourth, the desirability of candidate industries should be weighed with respect to social features affecting the life of the local community, the region or nation, and the international community. This is treated in Chapter XII.

REFERENCES, CHAPTER VIII

1. For readers trained in economics, illuminating technical discussions of the issues dealt with in the preceding section and of certain related questions are found in:

   Kahn, Alfred E. "Investment Criteria in Development Programs." Quarterly Journal of Economics, February, 1951, pp. 38-61.

   Chenery, Hollis B. "The Application of Investment Criteria." Quarterly Journal of Economics, February, 1953, pp. 76-96. This is a mathematical treatment of the problems of calculating the social benefit to be expected from alternative projects in underdeveloped areas.

2. There are chapters on manufacturing costs, cost accounting, factory budgeting, financial planning, and other topics related to estimating net return for a projected enterprise in the references on industrial management given at the end of Chapter IV—specifically, in the books by Alford and Beatty, Alford and Bangs, Goetz, and Hempel.

   The following additional reference is directly on the problem of estimating:

   Aries, Robert S., and Robert D. Newton. Chemical Engineering Cost Estimation. 2d printing. Brochure issued by Chemonomics, Inc., 400 Madison Avenue, New York 17, N. Y., 1951. While this is specifically concerned with estimating procedure in the chemical industries, its suggestions should be helpful also to those concerned with other types of manufacturing. Includes a bibliography.

Chapter IX

THE TEST OF INTEGRATED DEVELOPMENT

To make a fair appraisal of the relative merits of different candidate industries from the point of view of a developing country it is not enough to consider only the direct output of each industry. Some industries will probably offer more than others in the form of indirect benefits through making it possible for other manufacturing industries to be more productive and through encouraging development in related fields such as agriculture, transportation, and education. It is the purpose of this chapter to indicate the nature of these indirect benefits and to suggest the kinds of information which should be sought in evaluating candidate industries from this point of view.

In Exhibit IX-1 a number of points are presented on which each candidate industry should be examined. With the help of the questions indicated, and after the necessary factual information has been gathered, the candidate industry should be rated on each point separately and then an average should be struck. Or, if preferred, the over-all impression which emerges from studying the industry in relation to the entire list of questions can be expressed in a single rating. A rating scale of 1 to 5 is suggested, where 1 means very poor, 2 poor, 3 medium or average, 4 good, and 5 very good.

COORDINATED DEVELOPMENT

Where the benefits to be expected from an entire interdependent group of industrial projects are substantial, the fact that Industry A, for example, is an important link in this group gives it additional value to the economy. Sometimes candidate industries cannot be fairly appraised as isolated undertakings, but only as integral parts of whole constellations of industrial and perhaps also extraindustrial projects. Industries that tend to locate near each other or to grow up together may form a natural industrial constellation because they use each other's products, or look to common supply sources for materials, or to common transport, power, or marketing facilities, or have common educational or vocational training needs. In such cases it may be advisable to treat a whole constellation as one "candidate," rather than the separate industries that make it up, or possibly the industries should be examined both separately and as a unit composed of several industries.

Exhibit IX-1

APPLYING THE TEST OF INTEGRATED DEVELOPMENT

Coordinated Development

1. Industry constellations.

   Is the candidate industry one of an interdependent group of industries? If so, perhaps the group should be evaluated as a unit on the various tests recommended in this Manual. If the group ranks high in such an evaluation, then ask: Is the particular candidate industry, whatever the outlook for it singly, likely to be important to the success of the industry group, and would its absence seriously weaken the prospects for the whole group?

2. Development goals.

   Does the candidate industry fit particularly well into the long-range course of economic development that is planned or foreseen for the area?

3. Developments elsewhere.

   Taking account of trends and development plans in other areas, does it appear that rising competition or growing markets will affect the prospects for the candidate industry unfavorably or favorably?

Developmental Leverage

To what extent is the candidate industry likely to advance the productivity of other industries or other sectors of the economy, and thus produce an indirect benefit in addition to its direct output? Consider:

1. Personnel training.

   Is the candidate industry particularly good as a training ground for: (1) factory operatives, machine tenders; (2) skilled mechanics, maintenance men, industrial craftsmen; (3) industrial office personnel; (4) skilled industrial managers, supervisors? Are the skills acquired in it readily transferable?

Exhibit IX-1 (Continued)

2. Transition to the industrial system.

Is the candidate industry especially useful as a means of providing incentive goods or market outlets or employment which bring rural subsistence farmers and other groups into the money-exchange economy for the first time?

3. Marketing facilities and merchandising techniques.

Will the candidate industry introduce facilities and techniques in connection with the marketing of its own products that will also make it easier to market the products of some other industries (or of other sectors of the economy, such as agriculture)?

4. Transportation facilities and other industrial utilities.

Will the candidate industry bring about the development of new transportation, power, and other facilities that will also be useful to other industries?

5. Business and financial facilities.

Is the candidate industry likely to make a good demonstration of the corporate form of business organization and financing and to encourage further placement of funds in industry?

6. Supply of materials, parts, and industrial services.

Will the candidate industry make available—either directly or through inducing production by others—materials or component parts or services that are needed by other potentially promising industries (or by other sectors of the economy, such as agriculture)? Will these be available at lower cost because of the existence of the candidate industry?

The prospective value of a candidate industry to the developing area also depends upon the general fields of economic activity in which the area can expect to achieve sound long-run growth. How well does the candidate appear to fit into the course of development that can be foreseen or that is being planned? In order to appraise a candidate industry's possible contribution to the development of future industries, it is necessary to know what kinds of other industries may be expected in the future.

For example, a small steel-making operation using scrap as the principal raw material is not too difficult to establish. Depending upon the circumstances, such an operation could have a great or small effect on further developments. If the industry will serve an area which is potentially a large market for steel, and if iron ore and energy are economically available or will become so in the course of development in the area, the initial steel operation could be the nucleus around which an integrated steel industry would eventually grow. This sequence of development has occurred in Chile. If, on the other hand, the area is small, and little growth is foreseen for the metal industries, railroads, and other steel-using activities, or if the area has no potentially economic source of iron ore and energy, the initial steel operation may serve only to give the area a relatively high-cost source of steel. Costly steel not only may fail to stimulate further growth, it may actually handicap the growth of steel-using industries. Similarly, in the agricultural field, an industry processing a local farm crop may stimulate further planting of this crop, which in turn will support growth in the processing industry. But this integrated development can only occur when the area is favorably situated in relation to other areas for the production of the agricultural raw material and has access to adequate markets.

For best economic results, the choice of industries for development in the area must also be coordinated with the trends and the development plans of outside areas. It would not be wise to establish a candidate industry which will shortly lose its market to a similar industry more favorably situated in some other area. If the candidate industry is to depend on one or more imported materials, the possibility that the materials supply will be limited and the cost increased by the development elsewhere of industries using the same materials must be considered. Improvement of transportation facilities which may be expected in the future may expose the candidate industry to outside competition which is not presently a factor. Since a great many areas in the world are now pursuing active programs of economic and industrial development, the situation is a dynamic one, and relative advantages of areas can change rapidly.

Such possibilities should be carefully considered, lest industries be selected which will become liabilities in the future instead of assets.

DEVELOPMENTAL LEVERAGE

Specific ways in which a new industry may serve to increase the productivity of other industries will now be considered. It is likely that some candidate industries will on examination be found to offer greater advantages in this respect than other candidates. If so, they may be said to have greater developmental leverage.

Personnel Training

Shortages of persons with the skills and work habits required in industrial operations often retard the growth of industry in newly developing areas. Programs of general education and vocational training will help to overcome such shortages, but equally important is the "learning by doing" which comes from actual work experience in industry. From this point of view two types of candidate industries have special attraction, the relative value of the two depending somewhat on the stage of industrial growth at which the developing area finds itself: (1) industries that will employ large numbers of inexperienced persons and rather quickly impart simple factory skills and work habits, and (2) industries which afford training in advanced skills of a widely applicable sort.

The first type of industry may be especially important in building up an industrial labor force in the early stages of development. People who have never before worked in a factory may acquire not only the specific skills of their jobs, but also, and probably more important, the habit of working at a regular job steadily and under supervision. Work habits, dexterity, and basic machine skills are readily transferable over a wide range of industries. The initial experience is likely to make it possible for employees to adapt readily to the requirements of work in other lines of industry and to upgrade their skills when the opportunity offers.

The textile industries in the past have been notable for providing industrial training grounds in newly developing areas. This is probably because they employ relatively large numbers of people at jobs which can be rather quickly learned. The chemical industries, on the other hand, typically employ very few persons in proportion to the value of their output and they require many advanced skills which are not readily acquired on the job.

The second type of industry is a training ground for various kinds of skilled workers needed throughout industry—mechanics, machinists, electricians, welders, tool and die makers, etc. Industries in which there is need for much maintenance work on machinery and heavy equipment afford opportunities for this kind of training. For example, the centrales which process sugar cane in Cuba and some other Latin-American countries have raised the general level of mechanical skills and have also made such skills available in outlying regions. Automobile repair shops (in an earlier day bicycle shops) give many mechanics their first experience.

The problem of training personnel is not confined to mechanical skills. Of first rate importance in the success of an industrial enterprise is competent supervisory and managerial personnel. Supervisors must be proficient in the art of handling people. This art is applicable to all industries and is readily transferable from one to another. In this connection the mass employment industries might be thought to provide opportunities for more persons to gain supervisory experience. However, supervisors must also be proficient in the particular operations with which they are concerned, and this necessity for specialized experience and for understanding of special processes and techniques tends to limit their mobility among industries. It is difficult to determine which industries are likely to be most advantageous in providing a body of competent, experienced foremen.

With respect to management training the situation is much the same. Basic management techniques and skills in dealing with people are the same in all industries, but each industry has its own requirements in specialized techniques. So far as our present knowledge goes, there is little basis for selecting industries which could be expected to be much better training grounds for management than other industries, though conceivably a systematic study of experience might throw more light on this question.

Transition to the Industrial System

For an area to develop industrially it is necessary that the individuals living in it alter their way of life in many respects. Subsistence agriculture and barter exchange must give way to specialized occupations and the purchase and sale of a money economy. New skills must be learned, new products must be made, and new products must be purchased. Where there is much resistance to such changes the process of industrial development and of economic development in general will be slow. It is probable that some industries can

assist more than others in inducing people to make the adjustments that are necessary to a modern system of production. Where this type of transition problem is especially important, the ability of a candidate industry to encourage and facilitate the transition should be given special weight.

Where large segments of the population live in rural districts and engage mainly in subsistence farming, the establishment of small-scale industries in towns or villages may help to start an upward spiral of increased productivity by providing some people with factory employment at which they can earn a cash income. Also, properly chosen manufacturing industries may ease the transition from a subsistence economy to a money economy by providing a cash market for locally produced materials. The existence of a processing plant, such as a cannery or a creamery, makes it worthwhile for farmers to produce a surplus beyond their family's need for food, and to engage in more specialized production. The new cash outlet for their produce will also bring the former subsistence farmers and their families into the market for the first time as customers of industry.

In this connection, the availability of desirable consumer goods can be a powerful incentive to induce people to change a whole way of life and to work for a money income, either by producing crops for sale or by taking a job in industry or commerce. In the early stages of economic development, while productivity and incomes are low, low-priced goods which can be bought without the necessity of a lengthy period of saving are likely to be the most effective incentives to induce people to become part of the money economy. Weight should then be given to this factor in choosing among candidate industries.

Marketing Facilities and Merchandising Techniques

The development of manufacturing industries is closely linked to the adequacy of arrangements for distributing their products to users. We have noted in an earlier chapter how the introduction of modern merchandising methods—exemplified by the operations of Sears Roebuck and Company in Mexico and certain other countries—can act as a powerful stimulant to local manufacturing. In this case, of course, the improved marketing channel was created by the activities of a merchandising firm. Opportunities for a manufacturing industry itself to create a marketing channel which opens up new possibilities for other manufacturers are perhaps not so obvious, but nevertheless they exist.

For example, if a manufacturer of perishable food items were to establish a special sales and delivery system in order to deliver his product fresh and wholesome to retail outlets at frequent intervals, the makers of other perishable products could perhaps use the same system and share the cost, or the original manufacturer could later enlarge his product line to utilize the facilities more fully. In the United States a delivery system developed for fresh yeast provided the basis for the growth of a very large diversified business.

Again, refrigerated storage is essential to the distribution of many perishable products. Once such storage facilities are installed in central distribution points and in retail outlets, opportunities are open for similar handling of many other items. Refrigerated cabinets might be introduced at the retail level by the bottled soft drink industry, for example, and this could open wider distribution opportunities for dairy products and other refrigerated items. Meat packing plants and breweries might serve to introduce central cold storage facilities by making part of their space available to the manufacturers and distributors of other products and spreading the cost.

Areas in the early stages of industrial development are usually handicapped in the marketing of their products by lack of adequate standardization and grading. In the marketing of hides, for example, large and small hides are mixed together, hides scarred by thorns and brush are mixed with smooth ones, branding and skinning practices vary, etc. This makes it difficult for tanners to buy without waste or tedious inspection and serves to hinder the growth of a leather industry. Unstandardized manufactured goods are difficult to sell in volume, and the growth of an industry may thereby be retarded. For example, a large number of small cheese plants may each produce a cheese different in quality from the others. This complicates the distribution and sales promotion problems of the industry and limits its growth. A candidate industry which shows promise of having a desirable standard and leading the way for others in these matters would be contributing indirectly to the country's general industry growth.

Transportation Facilities and Other Industrial Facilities

Good transportation facilities are important in the marketing of manufactured products, and therefore this topic is closely allied to the preceding one. But also manufacturing industries require transportation to the plant sites in order to bring materials and equipment. Railroads, highways, and waterways are expensive to build. Many industries must depend on existing transportation rather than take the lead in developing their own facilities. This is

almost certain to be the case unless heavy tonnage is involved. Because of the need for tonnage to support transportation systems it is often found that mining, logging, and agriculture are primary influences in obtaining the construction of new facilities. This is particularly true where the service must cover a large area. But some manufacturing industries can also be instrumental in bringing about the building or improvement of transportation lines.

In the case of manufacturing, a new industry is more likely to bring about the extension of a railroad, highway, or waterway to a new plant site than it is to initiate construction of a new network. Even this limited extension of transportation can be important, however, because the property near the plant site also has access to it and thus becomes usable by other industries. A heavy-tonnage industry is likely to be most effective in this connection. A steel mill, cement plant, brick factory, saw mill, or similar heavy-product industry can often attract or provide new transportation to a plant site. The same principle applies to provision of other industrial utilities at a new plant site—for example, power lines and water mains. A candidate industry which in meeting its own needs brings about such development may also make it easier for other industries to grow.

An industry which leads to the introduction of specialized carriers such as refrigerated cars, gondolas, tank cars, or refrigerated trucks may assist other industries in which the raw materials or the product require similar specialized transportation. Once the equipment is available, industries that ship such small quantities that the equipment could not be economically provided for them alone will be able to utilize the equipment on a part-time basis.

Business and Financial Facilities

Areas in the early stages of industrial development often lack effective ways to bring enough capital together for large undertakings. Experience with the corporate form of business organization and financing is likely to be limited. The practice of confiding the management of business property to persons not connected by family ties may be little known. In such circumstances a candidate industry which can offer an example of successful multiple-owner financing and management may show the way toward a more effective use of the capital funds available in the area. Appraisal of the candidate industry on this point will depend not so much on the type of industry as on the persons who propose to organize it and the methods which they propose to use. A successful example could have a

favorable effect on future development in many other kinds of industry, and a failure could discourage further ventures and retard the industrial development of the area.

Supplies, Materials, Parts, and Industrial Services

One of the most important ways in which a candidate industry may affect other industries is through a common relation to some material or product or service. These relations take two forms: (1) The candidate industry may produce items which are used directly by other industries in the manufacture of other goods—for example, tin cans or glass bottles used in food manufacture, foundry products used in making machines, electric motors used as components in many manufactured items. (2) The candidate industry may require a raw material which can also be used by other industries—for example, it may need a steady supply of steel forgings, or sulfuric acid, or plastics materials. Both effects should be considered in studying a proposed new industry.

Cases in which a candidate industry would directly provide materials or parts used by other industries are numerous. The primary metal industry supplies sheets, strips, plates, bars, and other forms which become the principal materials used in a host of metal-fabricating industries. Oil refineries supply fuels, lubricants, and chemical raw materials used in many other industries. Manufacturers of electrical equipment supply switches, motors, thermostats, etc., which become parts for the manufacturers of a multitude of machines and appliances. Even the waste products of one industry can become the raw materials of another. Blast furnace slag is widely used in the manufacture of cement, for example. In Argentina a small industry making grape-seed oil, alcohol, and tartaric acid from winery waste has developed.

Caution with respect to the argument that the so-called "basic" industries should be specially encouraged at an early stage in industrialization has already been given (Chapter VIII). The limitations imposed by a small market are particularly important. Nevertheless, where a candidate industry which does appear feasible will make it easier to establish or maintain other desirable industries that use its products, this is certainly a point to be rated in its favor.

Examples of ways in which a new industry may contribute to the development of a raw material supply for its own use, which can then be used by other industries are also numerous. A sawmill which causes logging operations to develop opens up a raw material supply for other plants using logs, such as makers of veneer and

plywood, shingles, ties, poles, pilling, cooperage, and fiberboard. A plant to make powdered or evaporated milk may so stimulate dairy output that cheese plants and butter production can also begin. An industry which leads to the development of a local fuel, power, or water supply by providing an outlet for large quantities of these essentials also makes them available for other industries. A fertilizer industry which uses large quantities of sulfuric acid may make possible local acid production, thus improving the supply of a material essential in many other industries. In Chile the increased output of limestone stimulated by a new steel mill is expected to encourage the production of fertilizers, soda ash, caustic soda, and sodium bicarbonate.

Closely related to the effects of a new industry in generating a supply of raw materials or manufactured parts are its possible effects in creating a supply of industrial services useful to other industries. If an industry is established which has a substantial need for the services of architects, engineers, research scientists, testing laboratories, training schools, repair shops, advertising agencies, printers, lithographers, or metal plating and galvanizing plants it may be the means of attracting such persons and facilities to the area. Once located in the area their services become available to the other industries with lesser needs which could not have brought about the initital establishment of the services. This, too, is a possible indirect benefit to be weighed in evaluating a candidate industry.

Chapter X

THE TEST OF STABILITY AND GROWTH

Some industries are more subject to seasonal swings in demand and employment, or more sensitive to business booms and depressions, than others. The outlook for some is more strongly affected by international political conditions, manifested, for example, in embargoes on strategic products in other producing areas. Some industries are more influenced than others by rapid technological change, the exhaustion of a raw material source, or shifts in consumer preferences.

Other things being equal, an industry which helps to counteract the instability of other industries or of agricultural fluctuations in the area—as by having its busy season at the slack season of other activities—is especially valuable. Nonindustrial areas have in the past experienced economic fluctuations largely in response to changes in the volume or price of their exports. Since many of these exports have been agricultural products, a decline in the value of exports has usually led to rural underemployment rather than to the more conspicuous urban unemployment which accompanies a decline in industrial output. As an area becomes more industrialized, it becomes increasingly exposed to the risk of concentrated urban unemployment. Hence, the problem of economic fluctuations is one which will undoubtedly receive increasing attention. For all these reasons, in considering the suitability of a candidate industry its stability characteristics deserve to be weighed carefully.

It is important in economic development and specifically in industrial development to build up momentum. This means reaching a stage in which existing industries attract other industries, and growth leads to further growth. From this point of view a candidate industry which has good prospects for growth in the years following its establishment becomes much more attractive than a candidate industry which seems likely to remain small. A growth industry also entails less risk.

Exhibit X-1 suggests questions which should be asked about the stability and growth characteristics of each candidate industry. After the pertinent facts have been studied, the candidates should be given comparative ratings—for example, on a scale of 1 to 5, with the higher number indicating a more favorable rating. A candidate industry can either be rated separately on each point in the list, after which the separate ratings are averaged, or one

Exhibit X-1

APPLYING THE TEST OF STABILITY AND GROWTH

Prospects for Stability

1. Seasonal influences.

   Is the candidate industry one in which production and employment fluctuate with the seasons? Extremely, or only moderately? Do the ups and downs of employment come at the same times as those of other economic activities in the area, or at contrary times? If the busy season of the candidate industry coincides with the slack season of other activities in the area, can use be made of some of the same labor, thus tending to regularize employment?

2. Cyclical influences.

   Is the candidate industry one in which production and employment fluctuate violently in business booms and depressions, or does it maintain a comparatively steady rate of output?

3. Other influences affecting stability.

   Are there special sources of instability which are likely to bring large fluctuations of production and employment in the candidate industry? Consider for example, the degree to which it may be vulnerable, under the circumstances of the area, to difficulties in obtaining imported supplies, to intensified competition in export markets, to sudden technological change, to changes in consumer preferences, or to exhaustion of sources of materials.

4. Flexibility.

   Is the candidate industry one in which the equipment and the skills are usable only to make one product or a narrow range of products? Or are the equipment and skills readily adaptable to a wide range of products, thus affording more flexibility with which to face the uncertainties of the future?

Exhibit X-1 (Continued)

Growth Prospects

1. Technological prospects.

   Is the candidate industry one that appears to be headed for obsolescence because of new products and processes or is it one in which the trend of technological development is likely to bring further expansion?

2. Development trends and programs.

   What is likely to be the impact on the candidate industry of long-range development trends and programs in the area? For example, is the industry a producer of construction materials or equipment that will be needed in increasing quantities as the area continues to develop? Or is the need for its product largely temporary?

3. Impact of buying power shifts and consumer preferences.

   Is the candidate industry one that is likely to experience a strongly increasing demand for its products as incomes grow, as new groups of people acquire buying power, and as consumer needs and preferences shift with increasing industrialization and urbanization?

rating can be given to express a general impression of the industry's merits with respect to the whole list of points in Exhibit X-1.

PROSPECTS FOR STABILITY

Seasonal Influences

The output of many industries is closely related to the season of the year and goes through fairly regular annual fluctuations as the seasons change. A major source of such fluctuations is found in variations in raw material supply. The production of most agricultural crops is strongly influenced by the alternation of summer and winter temperatures or the rainfall variations between the wet and dry seasons. Processing industries which depend on agricultural raw materials are therefore likely to be characterized by seasons of peak activity and employment followed by periods of inactivity between crops. Food canneries, for example, tend to have such a pattern, although they are sometimes able to spread their work over fairly long periods by handling two or more crops with different harvest seasons. The extraction of sugar from sugar cane takes place during a few months in Cuba and certain other countries of Latin America; the time between cane harvests is widely spoken of as "the dead season." The dairy products industries are strongly influenced by seasonal variations in milk production. Logging and sawmill operations may be restricted in winter or in the rainy season.

Industries in which the raw material supply is not affected by the change of seasons may nevertheless experience strong seasonal fluctuations arising from influences on the demand for their products. For example, sales of agricultural machinery and fertilizer are closely tied to the crop seasons in which such products will be used. Sales of rainwear are obviously greatest in the rainy season. Straw hats and other seasonal apparel can be sold only in short periods of the year in those areas subject to climatic variations. Various holidays also create peaks in the demand for products characteristic of the holidays. Candy, liquors, and special foods are likely to be affected in this manner. An extreme case is Christmas ornaments and decorating materials.

The sales of items widely used as gifts tend to be concentrated in holiday seasons, and in the United States this effect has become pronounced even in such products as refrigerators, washing machines, and other household appliances. Refrigerators and electric fans of

course, enjoy another peak season in anticipation of summer heat. The production of automobiles, tires, and gasoline is influenced by the weather cycles favorable and unfavorable to motoring.

It can readily be seen that some element of seasonality is present in a wide range of industries. In some it is much more pronounced than in others. Products which can be stored easily may be produced on a year-round basis, thus accumulating stocks for the peak season. However, this entails a burden of interest expense and other storage costs from holding unsold goods, as well as risks with respect to styling and amounts to be produced in advance of the peak season. When seasonal labor is available it may be preferable from the manufacturer's point of view to concentrate production in the periods of active sales. This is particularly true if no specialized labor skills are required. When there are significant advantages in having a specially trained labor force there is a corresponding inducement to keep operations on a regular year-round basis in order to retain the necessary persons who have been trained.

The principal disadvantage of a highly seasonal industry in an economic development program lies, of course, in the unemployment or underemployment of workers in slack seasons. Such periods of unemployment may make it difficult or impossible for the persons involved to earn an adequate annual income unless there are alternative sources of employment during the slack seasons. In the early stages of industrialization, when the number of industries is limited, and in areas in which there is a high degree of specialization in one or two industries because of local advantages for those industries, the opportunities for alternative employment are also limited. Particularly in conditions such as these a strongly seasonal industry can create difficult problems.

It is occasionally possible to foster in an area two or more industries in which the seasonal peaks come at different times of the year, thus providing about the same total employment the year round. There are limitations, however, on the transferability of labor skills from one industry to another. Labor shifts between industries may be blocked by sheer differences in the skills required. It may also be blocked by the unwillingness of persons employed in skilled jobs in one industry to accept jobs requiring lesser skill in another industry. Differing labor union jurisdictions may also discourage movement from one job to another. These factors should be considered carefully in deciding whether a candidate industry would be useful in filling a seasonal gap in another industry. A fertilizer plant and a garment factory, for example, would not be likely to assist each other in this respect even though their peak

seasons come at different times. On the other hand, a dairy products plant and a candy factory might well complement each other very well in providing year-round employment.

Cyclical Influences

The general level of economic activity in an area fluctuates from time to time for a variety of reasons not connected with the annual passage of the seasons. Periods of high activity and employment tend to be followed by periods of lower activity. These fluctuations may extend over a number of years and are commonly referred to as business cycles.

It is well known that certain industries are more strongly affected than others by such changes in economic activity. A cyclically depressed industry creates unemployment and hardships for individuals and serves to retard the progress of economic development. If there are only a few industries in the area the impact of depressed conditions in any one of them becomes relatively more important than in a highly diversified economy. A newly developing area will therefore wish to give serious attention to the cyclical characteristics of candidate industries and will prefer those industries offering a reasonable degree of stability.

The relations of different industries to changes in the general level of economic activity have been studied at length in industrial countries such as the United States. It is well known, for example, that industries producing capital goods such as machinery and factory equipment are strongly affected by cyclical fluctuations. Business firms invest in new plants and equipment primarily in times of prosperity and rising sales; they restrict capital expenditures in times of poor business. This same tendency is manifest at the consumer level, where the sale of durable goods such as furniture and household appliances is greatly accelerated in times of high employment and high incomes and falls off rapidly in times of business recession. The fact that such items are durable means that they can be used over varying periods of time, and replacement seldom becomes imperative. Old furniture and appliances can be repaired and made to last over a period of reduced incomes if necessary. On the other hand, consumer goods which are used up immediately must be replaced at regular intervals and tend to be less affected by changes in income and employment. Food is perhaps the best example of this type of product.

Another basis for distinguishing between products likely to be strongly affected by the business cycle and those less affected is

found in differences between luxury items and necessities. Luxuries can be given up in times of reduced income, while necessities must still be purchased. Although food in general is a necessity, there are nevertheless many luxury foods which can readily be eliminated from the diet if incomes fall. Influences such as these can be traced in the behavior of many products.

Some care must be used in appraising the probable cyclical behavior of a candidate industry in newly developing areas, because the patterns which have become familiar in the industrial countries will not necessarily be duplicated. A fundamental difference between the industrial countries and the newly developing areas lies in the relatively greater influence of changes in the volume of exports and imports on the economies of the latter. If the price of a major export, such as coffee, is high and if the local crop is good, export earnings will be high. This not only stimulates the local demand for goods and services, but it also provides foreign exchange for the purchase of imports. If the price of coffee goes down, or if there is a local crop failure, domestic business is depressed, and funds for imports are diminished. Under these conditions a candidate industry which in a large industrial country would be considered relatively stable from the business cycle viewpoint might be seriously affected in a newly developing area. This could be the case if the industry were dependent on substantial imports of raw materials, for example. If industrial development has yielded a number of industries which are engaged in processing imported materials, a reduction in available foreign exchange may make it impossible to meet the requirements of all of them. It will therefore be well in evaluating a candidate industry to consider its import requirements in relation to the import requirements of existing industries and in relation to the total import volume which can probably be maintained in times of cyclical depression in the export industries.

The selection of industries so as to minimize vulnerability to cyclical fluctuations involves many considerations and is by no means simple. Some ideas bearing on the cyclical problem as it relates to development programs are presented in an essay prepared for the Economic Commission for Latin America by Raul Prebisch.(1)

Other Influences Affecting Stability

Particular industries may be subject to fluctuations in employment and output arising from influences which do not affect the economy as a whole. A candidate industry should be examined for characteristics which expose it to unusual disturbances.

International political developments can suddenly alter the status of numerous industries. While such events are likely to have the strongest impact on raw materials production and shipping services, they can also affect manufacturing. Imported materials, parts, supplies and equipment necessary to an industry may become difficult to obtain abroad due to expansion of defense production or stockpiling programs. Similarly, competition in export markets may be intensified by the cessation of such programs and the release of production capacity abroad.

Industries characterized by rapid technological change may suffer instabilities as the introduction of new products and processes renders old ones obsolete. This type of instability can be found in the electronics and pharmaceutical industries, for example. While both of these industries are growing rapidly and will continue to do so, the fortunes of individual firms are closely tied to research efforts and the rapid development of new and improved products. Where the industries are composed of many firms and of large diversified firms as in the industrially advanced countries, the necessity to abandon a specific product can usually be handled without a major disaster. In a newly developing area, on the other hand, where new firms may be small and dependent on a narrow range of products the impact of such changes could be severe. The ability to keep pace with competitive developments and to adapt to new situations will be important in appraising the suitability of candidate industries likely to be subject to sudden changes. Rapid amortization of investment in specialized equipment is necessary in these industries, and sufficient capital to finance new equipment is essential.

A situation analogous to that described with respect to technological change can arise from changes in consumer preferences. Extreme cases of instability from this source are found in those industries in which style and novelty are important in product appeal. Women's apparel accessories, such as handbags and costume jewelry, fall in this category. An unpopular design or failure to estimate properly a fashion trend can cause a sudden period of difficulty for firms in such fields.

It is feasible to establish some manufacturing plants on what is known to be a temporary basis in order to take advantage of a limited supply of raw material or to exploit a market situation. Sawmills are often moved into an area to cut a small stand of timber and are moved to new locations as the timber is exhausted. High-cost sources of minerals may be worked in times of high market prices and abandoned when prices fall. While such industries may serve a useful purpose, their transient nature should be recognized so that problems arising when they cease operations can be anticipated.

Flexibility

Some industries can readily turn their equipment and their trained labor force to the production of any of a considerable range of products, not all of which are sold in the same market or to the same type of customer, and not all of which are subject to the same technological changes or other uncertainties. A plant making molded plastic products, for example, may be able by a fairly simple shift in molds to produce plumbing supplies one month and toys or radio cabinets the next. (On the other hand, the making of molded plastics products might be vulnerable to possible interruptions in the supply of the right kinds of materials.) Some other industries, of which brickmaking and cementmaking can serve as examples, use highly specialized equipment and skills which are not readily adaptable to production of other things. Manufacture of bricks and cement may be so advantageous for other reasons that on balance these industries are worth undertaking despite the greater risks associated with single-purpose plants. But newly developing areas in which there is not yet much industrial diversification should be alert to encourage the more adaptable types of industry which can change products if necessary to meet unforeseen circumstances and thus probably maintain greater stability of production and employment.

Growth Prospects

Since the objective of economic development is to increase employment, income, and the output of useful goods and services in the area, there are obvious advantages in choosing for development industries which may be expected to grow rapidly once they are started. In addition to the benefits which come directly from the rising output of the growing industries, such growth will provide an increasing stimulus to supporting industries and services which may also be started in the area. From the point of view of the business enterprise, a growth industry offers a greater profit potential and entails less risk than an industry in which the expansion possibilities are limited. If the present market proves to be smaller than predicted, leaving the plant with excess capacity, this will be only a temporary situation in a field where the market is growing rapidly. Also, from the point of view of the economy as a whole, there is less risk of waste and loss from misdirected efforts and false starts in growth industries, and the net return to the economy is likely to be better. Among candidate industries, therefore, those with good growth prospects will be especially attractive.

Different Rates of Growth

At any given stage in the economic development of an area there will be some industries which are experiencing an upward trend in employment and output and other industries which are in a declining trend. Which industries are growing and which ones are declining will be determined by the interplay of many factors. Technological developments yielding new products or replacing old ones are very important in this respect, as are the speed and direction of an area's development program, changes in consumer buying power, and changing patterns of consumer preferences. The latter are in turn related to income levels, educational levels and cultural factors.

The phenomenon of industrial growth has been the subject of considerable study in the more highly industrialized countries. In the United States, for example, much information on the relative performance of various industries and products has been tabulated. The average annual percentage rates of growth in the output of certain products in the United States in the period 1940-1951 are shown below to illustrate the extreme differences which can occur. While antibiotics and television sets were more than doubling in volume from year to year, steam locomotives and other products were declining in output from year to year.

Product	Annual Growth Rate 1940-51 Percent
Antibiotics	118.0
Television sets	113.2
Synthetic detergents	41.4
Man-made fibers, other than rayon	40.5
Radio sets	0.6
Men's suits	minus 1.9
Soap, excluding synthetic detergents	minus 2.0
Steam locomotives	minus 15.8

These few examples are sufficient to illustrate a variety of influences at work. The enormous growth in antibiotics and television sets represents technological advances which made possible the volume production of new, strongly desired items. It also reflects a willingness of consumers to accept new things and a high level of consumer incomes, which provided a wide market for these products. The rise in synthetic detergents also represents a technological innovation coupled with consumer willingness to try

new products, and it has resulted in an actual decline in conventional soap production. This shift in the output of cleansing agents has had important effects on the industries supplying raw materials, because the synthetic detergents are not made from conventional soap materials. Growth in population and high incomes have made it possible for radio set production to increase slightly in spite of the inroads of television. Although the total production of clothing has grown, the production of men's suits has declined, reflecting changes in consumer tastes and living habits which now direct more of the clothing expenditure toward sportswear. The steam locomotive has been largely replaced in the market for new railway equipment by the diesel locomotive. Even the diesel is nearing the end of its period of high production, because its market has been largely for the replacement of existing steam equipment rather than for expansion of the railroads.

Growth Patterns in Newly Developing Countries

In analyzing the growth prospects of candidate industries in a newly developing country it would be a mistake to use as patterns the recent experience of industries in highly industrialized areas such as the United States. Industrial growth patterns are strongly affected by the stage of economic development which has been reached, the levels of income and productivity which have been attained, the degree of technological competence which has been achieved, and also by the customs and culture of the area. Unfortunately, relatively little study has so far been devoted to the industrial growth patterns of less-industrialized but industrializing countries. Research on this topic would have considerable practical value.

A newly developing area will ordinarily start with a low level of income and productivity. A great many people will probably be underfed, ill-clothed, and poorly housed. As the economic development program begins to yield higher productivity and incomes, a strong demand for more food, clothing, and housing is likely to emerge. As incomes continue to rise, the per capita consumption of food measured in calories may be expected to level off, but shifts in the composition of the diet will occur. It has already been observed in Latin America that an upgrading of consumer tastes is going on, and as workers move to cities and earn higher incomes they tend to eat more meat, wheat, and dairy products and to eat less rural staples like corn and beans. The United States is still experiencing this kind of change in food consumption, with an ever-growing use of highly processed items and of foods with high vitamin and protein content. The food industry will grow rapidly in Latin America, but care will be required in directing investment to those product lines in which the new demand will make itself felt.

This example will serve to suggest the shifting demand patterns which may be expected in other product fields also, and it should be considered in relation to the discussion of income elasticity of demand in Chapter V. In each area it will be necessary to examine local conditions in the light of current achievements and consumer preferences in order to foresee the lines of greatest growth. Some time may be expected to elapse before industrial growth prospects in newly developing countries show patterns similar to those in presently highly industrialized countries.

In predicting the directions in which demand will expand as an area progresses in its industrialization, care in the interpretation of past demand patterns is also required. Where manufactured goods have in the past been largely imported, the volume of imports will have been strongly influenced by the quantity and price of exports from the area. Changes in the price of coffee, for example, may in the past have been more responsible for certain changes in imports of manufactures than any shifts in consumer preferences. Also, it is necessary to recognize that the rising income which will accompany economic development will be distributed in a new manner among the population. This is necessary for the success of economic development and may be assumed to occur in each developing area. This means that future growth in incomes will be translated into demand for goods through individuals with preferences different from those of the persons who have determined the spending of income in the past. These factors must be allowed for in estimating the growth prospects of different industries.

REFERENCES, CHAPTER X

1. United Nations, Economic Commission for Latin America. The Economic Development of Latin America and Its Principal Problems, 1950. II. G. 2. Chapter VII.

Chapter XI

THE TEST OF BALANCE OF PAYMENTS EFFECTS

Most developing countries have a pressing need for foreign exchange with which to purchase the equipment, materials, and services that need to be imported to advance their development programs, as well as to pay for imports of consumer goods which generally increase as development brings rising incomes. There are a few cases, illustrated by Venezuela's situation in recent years, in which export earnings are at such a high level, because of strong demand abroad for some commodity which the country is able to produce in abundance (in this case oil, and more lately iron ore), that there is no serious problem of ability to pay for imports. But these few cases are exceptional. Nearly all developing countries have to be much concerned with what is called the "balance of payments"—that is, the area's receipts of foreign exchange in relation to its expenditures of foreign exchange. Therefore, other things being equal, a candidate industry which promises to earn (or save) foreign exchange has a point in its favor as compared with a candidate industry which does not. Whether this point should be allowed to weigh very heavily or only lightly in the final choice of industries will depend on the area's balance of payments situation and outlook.(1)

The effect of a given industry on the balance of payments of the area may be complex. Whether the net result is to increase or to decrease the availability of foreign exchange will generally depend upon a variety of consequences that will partially offset each other. Figure XI-1 shows in condensed form the principal ways in which a candidate industry may influence the balance of payments situation. Each candidate industry should be examined with these possibilities in mind, and an attempt should be made to reach an estimate of the degree to which the industry would, on balance, have positive or negative effects on the area's foreign exchange resources. The candidate industries should then be rated comparatively from this point of view on a scale of one to five, as in the other recommended tests.

In the discussion which follows, positive effects on the availability of foreign exchange are described first and then negative effects.

Exhibit XI-1

APPLYING THE TEST OF BALANCE OF PAYMENTS EFFECTS

To what extent, on net balance, will the candidate industry add to or draw on the foreign exchange resources of the area?

Will it add to foreign exchange resources by:

1. Production and sale of export goods?

2. Helping to increase the exports of other industries?

3. Reduction of imports through substitution of products of the candidate industry?

4. Reduction of imports through substitution of products of the candidate industry for products of other local industries which use imported materials, supplies, etc.?

5. Attraction of foreign capital for investment in the candidate industry or in other industries which it helps to make more attractive to investors?

Will it draw on foreign exchange resources by:

1. Purchase abroad of machinery, equipment, services, etc. necessary to build plants in the industry?

2. Purchase abroad of new materials, supplies, spare parts, services, etc. necessary for operation of the industry?

3. Reduction in exports through attracting resources away from export industries to the candidate industry?

4. Reduction in exports through increasing the costs of export industries by making it necessary for them to use products of the candidate industry at higher prices than previously imported products?

5. An especially great tendency for increased consumer income generated by the candidate industry to take the form of additional demand for imports?

6. Repayment of foreign capital investment, transfer of earnings, and interest payments?

POSITIVE BALANCE OF PAYMENTS EFFECTS

Production of Export Goods

The most obvious way in which a candidate industry may increase the supply of foreign exchange in an area is by production of an item which is exported from the area and sold for foreign funds. This effect is easily recognized, and the problem of estimating it is like other problems of market estimation. It requires no further discussion here, except to mention that foreign exchange earnings from a new export industry may be offset in varying degree by a number of factors to be mentioned later. Determination of the net increase in foreign exchange earnings to be expected from a new export industry hence entails much more than the obvious tabulation of prospective sales to foreigners.

Increasing Exports of Other Industries

A new industry may improve the foreign exchange position of an area even though its own products do not enter foreign trade. One way in which this may be done is by making it possible for other industries to increase their exports. Interindustry relations have been discussed in Chapter IX, "The Test of Integrated Development"; and the points covered there need not be repeated. If the candidate industry will help to create a situation which makes it possible for an export industry to produce at lower cost or to better the quality of its product, the competitive position of the export industry in its foreign markets may be so strengthened that it can increase its sales and hence earn more foreign exchange for the developing area. For example, a fruit canning industry might lead to standardization and improvement in varieties of fruit grown in the area and to increased supplies and improved marketing facilities for fruit, all of which would in turn improve the possibilities for exporting fresh or dried fruit. Or the raw material needs of a steel industry might bring about the installation of transportation services to a formerly isolated area, in turn making possible the development and export of previously inaccessible minerals, forest products, or agricultural products.

Producing a Substitute for Imports

A candidate industry may contribute directly to an improvement in the balance of payments position by producing locally an item which must otherwise be imported, or by producing an acceptable substitute for that imported product. In such a case the candidate

industry eliminates the need to spend foreign exchange on the particular product affected and hence serves to increase the amount of foreign funds available for other uses. A great many candidate industries may be expected to fall in this category, since a newly developing area will have been drawing most of its manufactured goods from abroad and, as the local economy becomes more and more diversified, will naturally replace some kinds of imported products by goods of local manufacture.

It is frequently not possible to produce locally exactly the same product that is being imported, because brand names, trademarks, and other unique qualities may not be subject to reproduction. In this sense most locally produced manufactures would be considered as substitutes for rather than exact duplicates of imported products. However, in those cases in which branches, subsidiaries, or affiliates of foreign companies are established in the newly developing area it may be possible to duplicate exactly the imported product. Locally produced substitutes may not have buyer appeal equal to that of the imported items. Sometimes attempts are made to overcome consumer preferences for the imported goods by trade restrictions which give a high degree of protection to the local product. It is advisable to be alert, however, to the possibility that this may foster slipshod manufacturing or burden the area with uneconomic industries.

Producing a Substitute for Products of Import-Using Industries

A candidate industry may produce items which replace the products of other local industries that use imported raw materials, supplies, etc. If the candidate industry can use mainly domestic materials and supplies, there may be a net improvement in the balance of payments position. However, in these cases the forced decline of the import-using industries will tend to offset the effects of the candidate industry's rise so far as the generation of new income and employment in the area is concerned. Thus there may be little or no effect in expanding the economy, but the achievement of a more comfortable balance of payments position or a superior product might make the shift desirable. Examples of this type of substitution will not be as numerous as those of direct substitution of local products for imports; they are most likely to occur where recent advances in technology have made possible the use of new raw materials. A new paper mill, for example, using locally produced bagasse might replace an old mill using imported pulp.

Attraction of Foreign Capital

Some candidate industries are more likely than others to attract from abroad the investment capital necessary to build and equip a plant, train personnel, and begin operations in the newly developing area. If foreign capital can be obtained to cover equipment purchases abroad, the area may be relieved of the necessity of making substantial expenditures of foreign exchange. When the foreign capital is also used for local payments to labor and to suppliers of materials there is a direct inflow of new foreign exchange which becomes available for other uses.

Foreign financing from private sources is most likely to be available in the form of direct investments in which foreign firms establish branch plants or subsidiary companies in the newly developing area. These investments in turn appear most common in industries in which a large element of technological skill is present. Petroleum refineries, rayon plants, and rubber products plants have provided some conspicuous examples in Latin America. While the inflow of capital investment has a favorable effect on the balance of payments at the time the industry is being established, it also implies a reverse flow of foreign exchange in the future for orderly transfer of earnings from the new firms to their foreign backers and for eventual repayment of the capital sum. In the meantime, though, use of the foreign capital will presumably have increased the area's capacity to produce and to export.

NEGATIVE BALANCE OF PAYMENTS EFFECTS

Purchase of Capital Equipment Abroad

Most candidate industries will require imported machinery, equipment, engineering assistance, or technical services to establish a new plant and train local personnel in its proper operation. Some industries will have greater requirements in this respect than others. Some may need to expend sums of foreign exchange which are relatively large in proportion to the prospective outputs of the new industries. The balance of payments effects of large capital expenditures on imported equipment are obvious and need not be treated in detail here. These effects may be alleviated in some degree if foreign capital assists in starting the new industry.

Purchase Abroad of Raw Materials and Supplies

Even after the initial investment in new plant and equipment has been made some candidate industries will require continuous importation of raw materials, supplies, machinery parts, or technical services. This constitutes a constant drain on available foreign exchange and deserves careful consideration in appraising the industry's suitability for the area. Unless the candidate industry produces offsetting foreign exchange earnings or savings, the foreign exchange earnings of other industries must be relied upon to supply the foreign funds necessary for continued operation of the candidate industry. Selection of candidates of this type should, of course, be limited to a number which can be supplied with the required foreign exchange on a regular basis year in and year out.

A candidate industry which requires imported materials and supplies constitutes a relatively inflexible demand on available foreign exchange. That is, the imports of these materials cannot readily be shut off in times of balance of payments difficulty without causing serious repercussions in the local economy. If the industry is forced to shut down through lack of imported supplies, not only is the output of its product lost to the area but also the persons employed in the industry lose their sources of income, and a whole series of undesirable repercussions is started. This is why it is advisable to limit reliance on imported industrial materials and supplies to a volume which can be regularly maintained. Then fluctuations in the availability of foreign exchange would express themselves mainly in fluctuations in the volume of finished goods imported, which is likely to have less serious depressing effects on the local economy than industrial shutdowns.

Industries vary greatly in their requirements for imported raw materials and supplies. The food processing industries will use mostly domestic materials, as will forest products industries. The tobacco, leather, beverage and similar industries use a high proportion of locally produced materials. On the other hand, chemical industries in Latin America are likely to be dependent on a substantial proportion of imported materials, particularly in the early stages of development in this complex group of industries. Paper and metalworking industries draw heavily on imported materials in most cases, as do the rubber products and rayon textiles industries. Although the textile industry is one of the oldest and most widely distributed in Latin America, many Latin-American countries depend on imports for both natural and synthetic fibers.

Diversion of Resources from Export Industries

It is possible for a candidate industry to require the use of labor or materials which can only be obtained by attracting them away from present uses in export industries. If the candidate industry does not produce offsetting favorable effects on the balance of payments, the resulting decline in exports can cause the candidate industry to have a net unfavorable effect on the availability of foreign exchange.

If the candidate industry will be able to offer higher prices for the use of resources, for example higher wages for labor or more attractive working conditions, it may become impossible for existing export industries to obtain the resources they need at prices which will allow them to remain competitive in the world market for their products. Especially where a manufacturing industry is started under tariff protection in order to replace certain imports, the protected position of the industry may make it able to pay wages higher than an exporter can afford. In areas in which resources are not fully utilized there may be no actual diversion of resources from the export industries. But if labor or some other resource is in short supply, competitive bidding for the available supply can result to the detriment of the export industries. This type of effect has been seen in Australia in the postwar period, where there has been an enormous growth in the manufacturing industries, while the mineral and agricultural industries have either failed to keep pace or have actually suffered a decline in output. This has not only affected exports, but it has also caused shortages of raw materials for domestic use.

In evaluating this aspect of the balance of payments problem a long-range view is required. Although some resources may not presently be scarce, additional demands for them may be developing for the future. For example, a transportation or power project now under way may be opening up a new district or be making feasible a new process which can become the basis for an export industry which will use these resources, provided they have not been first pre-empted by another new industry.

Production of High Cost Supplies for Export Industries

A situation analogous to the diversion of resources from export industries can arise where a candidate industry would furnish supplies or parts to an export industry. If the items supplied by the candidate industry would be higher in price or inferior in quality to those currently being imported, the export industry would suffer higher costs,

an impaired competitive position, and the result might be loss of foreign exchange earnings for the area. Such losses must be weighed against the saving in imports that would be made possible by the candidate industry.

For example, suppose that the candidate industry were to manufacture machinery for use on an export crop, and that the machinery proved to be more expensive to purchase and operate than imported equipment: If producers of the export crop were forced to use the local machinery they might eventually find their costs increased to a point at which they could no longer compete in the world market. The volume of exports would hence fall. Similarly, the establishment of a local industry to produce packaging materials or to print labels might be protected by restrictions on the importation of these items. If the new industry should prove unable to maintain the design and quality standards to which export industries have been accustomed, the export industries may be placed at a disadvantage in their markets abroad. Difficulties in meeting high-quality standards are frequently encountered in new industries in developing areas; and especially where export industry will be affected care is needed in appraising the risk of such a situation.

Increased Demand for Imported Consumer Goods

An effect on the balance of payments which may be expected from all new industries arises from the additional income and consumer purchasing power generated by the new industry through its payments for the use of local resources—that is, through its wage payments, purchases of materials, etc. At least in the early stages of economic development, many desirable consumer goods can be obtained only through imports. Consumer income generated by the new industries therefore creates effective demand not only for local products but also for a wide range of imported goods, and tends to cause the expenditure of additional foreign exchange for the purchase of such goods. This effect, however, is inseparable from practically all kinds of economic development; after all, the purpose of economic development is to increase real incomes and effective purchasing power, and some of the increased purchasing power will express itself in new demands for imported goods. If there is reason to believe that a particular candidate industry would generate income in a region or among a social group that would be especially inclined to spend the additional income on imports, then this is a factor that might be taken into account in appraising the balance of payments effects. Ordinarily, however, there will be no firm basis for distinguishing between different manufacturing industries in this regard.

Repayments and Earnings on Foreign Capital Investment

A new industry started with the aid of capital from abroad must eventually provide for the transfer abroad of some of the earnings of the industry to cover interest or dividend payments. If the foreign investors want to withdraw their capital eventually (selling their shares to local people, for example) then this will require additional provision of foreign exchange at some time in the future. The repurchase of a foreign holding by local investors has the same balance of payments effects as the purchase of goods for import. It is necessary to look ahead in a development program to anticipate such future requirements for foreign exchange and care must be taken not to commit the area to more substantial future payments abroad than it will have the capacity to maintain.

REFERENCES, CHAPTER XI

1. A mathematical treatment of factors to be taken into account in determining what premium should be attached to types of production that earn or save foreign exchange as compared with production for local use is contained in:

Chenery, Hollis B., "The Application of Investment Criteria." Quarterly Journal of Economics, February 1953, pp. 76-96, especially pp. 81, 87-93.

Chapter XII

THE TEST OF SOCIAL DESIRABILITY

In comparing the merits of candidate industries consideration should be given to a number of social and social-economic relationships that bear on the value of an industry to its surrounding community. By "surrounding community" we mean three different levels of community relations: (1) the local community where the factory is situated, (2) the nation as a whole and its various regions, and (3) the community of nations.

Industrial Citizenship

Some types of manufacturing have a better reputation than others for establishing desirable working conditions, good relations between management and workers, health and safety practices, avoidance of air and water pollution, conservation of the natural resources used in the industry, and general awareness of the responsibilities of good industrial citizenship. Insofar as these traits do appear to be more characteristic of certain types of manufacturing and less of others, that fact should be weighed in selecting the types which it will be to the advantage of the developing area to encourage.

There is some evidence that the sense of responsible industrial citizenship is stronger in the newer industries based on more recent technological developments, such as the electrical industry, than in the industries where old traditions are stronger, such as textiles. However, good industrial citizenship and a positive sense of community responsibility are probably more dependent on the character and progressiveness of the particular management than on the past history and traditions of the industry. This is especially likely to be true in a newly industrializing region where no industry has had time to develop deeply rooted traditions.

Decentralization and Regional Balance

In the highly industrialized countries much attention has been given lately to the advantages of industrial decentralization, meaning smaller plants located in smaller cities and towns. A number of technological and economic tendencies, as well as such social considerations as the more desirable living conditions which this makes possible for factory personnel, seem to be working in this direction. Government and business leaders in newly developing countries

would be well advised to note this trend and to consider whether, starting with a relatively clean slate, they might not guide their own industrialization so as to move directly toward the decentralized arrangement that the more industrialized countries are now deliberately seeking. They could thus avoid some of the wasteful and socially harmful intermediate steps that the countries which industrialized earlier have had to go through.

Some industries lend themselves readily to decentralized patterns of development. Others require very large plants for reasonably economic operations or are almost compelled to locate in or near large cities because they must be close to a large market or to specialized services. The adaptability of the industry to decentralized development should be weighed along with other factors in comparing the merits of various candidate industries.

In many Latin-American countries the region around the capital city and metropolis has developed industrially and culturally far ahead of other sections of the country. A more even development is probably desirable on social and political grounds, and perhaps also on economic grounds, though the economic advantage is less certain. This is an additional point in favor of types of manufacturing that are adaptable to the hitherto neglected regions of the country (assuming that these regions do have development possibilities and are not destined by nature to remain waste areas).

International Implications

The living level of each country, as well as its outlook for freedom, social progress, and security is dependent to no small degree these days on happenings in the rest of the world as well as on developmental efforts at home. Therefore, the effects of each country's decisions on the general strength and sound growth of the community of free nations will also influence its own future well-being.

This suggests that in the selection of industries for development account should be taken of the possible international effects of choosing one rather than another. An industry which merely duplicates on a nationalistic basis productive facilities which already exist in neighboring countries and are ample for the present needs of the region is less desirable than one which supplements developments going on elsewhere. Industries that are well chosen from other points of view, such as their ability to produce at low cost for an expanding market, will generally fit well into a sound system of international exchange and, by increasing real buying power and the supply of marketable products

will promote healthy development of that system. On the other hand, industries that for a long time to come will only be able to exist if competitive goods from other countries are excluded or heavily taxed will tend to undermine the international trading system and to prevent the broader international development which is important for the prosperity and safety of all.

Exhibit XII-1 lists a number of questions which will be useful in applying to candidate industries the various criteria which we have suggested under the heading of social desirability. As usual, it is recommended that each candidate be rated on a scale of 1 to 5 on each of these points. Then each candidate's ratings should be combined into one summary rating that expresses its social desirability.

Exhibit XII-1

APPLYING THE TEST OF SOCIAL DESIRABILITY

1. Is the candidate industry likely to maintain a good standard of industrial citizenship in its local community in such respects as:

    a. Desirable working conditions?

    b. Good relations between management and labor?

    c. Health and safety practices?

    d. Avoidance of water and air pollution?

    e. Resource conservation?

2. Does the industry lend itself well to a decentralized, dispersed pattern of development in relatively small cities and towns, or would it tend to promote an undesirable degree of concentration in large, already overcrowded cities?

3. Does the industry promise to encourage a better geographical distribution of industry, as by helping to build up a relatively neglected region that nevertheless has possibilities?

4. Does the industry fit into a healthy pattern of international cooperation through trade, or would it merely duplicate on a nationalistic basis industries already under development in neighboring countries and have to depend on trade-blocking measures for defense against competition?

Chapter XIII

THE TEST OF EXPERIENCE AND COMPETITION

Finally, we suggest a test that comes at the problem of industrial selection from an entirely different angle. It overlaps all the other tests, and therefore can serve to confirm or to bring into question conclusions reached by applying them. We shall call this the test of experience and competition.

Instead of seeking to estimate directly how a candidate industry might fit into the conditions of the developing area, the test of experience and competition is based on the performance of the candidate industry in other areas where conditions are, or have been, not too dissimilar. It is recommended that these other areas be selected for this investigation which currently or in the fairly recent past could be viewed as roughly matching the area for which an industrial program is being drawn up. If possible, there should be reasonably close similarities in such characteristics as average income per capita, degree of industrialization already attained, types of resources available (including managerial skills), and cultural traditions. Areas which have moved a bit beyond the current level of industrial development in the area of principal concern, but not too far, ought to be particularly rewarding to study.

Having decided on several areas that offer as nearly as possible the desired matching characteristics, the next step is to look into the lessons that may be learned from practical experience with any of the candidate industries that have been undertaken in these areas. Exhibit XIII-1 suggests questions to which answers should be sought. Candidate industries should be rated comparatively on these points, using the same scale of 1 to 5 as for previous tests.

Has a particular candidate industry taken hold and flourished in several of these areas? Or has its establishment been repeatedly attempted and resulted in slight success or downright failure? An effort should be made to gauge the extent to which the candidate industry, where established, has really contributed to the increase of total economic output and to economic and social progress in these areas. Also, inquiries should be made of persons who know the situation in order to discover whether the industry has had a notable effect in stimulating other industries or in encouraging improvements in agriculture or other segments of the economy.

Particularly revealing will be the answers to the third group of questions suggested in Exhibit XIII-1. Here we have a test—the test of competition—that is both severe and objective. It can serve a very useful purpose by raising a warning flag where preliminary judgments may have been too much colored by the hopes and wishes of those planning industrial development and therefore may have neglected some harsh realities.

If an industry has shown outstanding ability to stand up to outside competition in other areas (similar to the one for which industrial plans are being made), this is a good indication that its technical and economic requirements can be satisfactorily met in such areas. If it has shown poor ability on this score, and continues year after year to demand subsidies or high barriers against competitive imports, then the indications are either (1) that the particular firms taken as examples are not well managed, or (2) that this line of industry is probably not as well suited as some others to the market conditions and resource availabilities of the areas examined. Unless there is some strong ground for believing that the industry, if introduced into the area for which industrial plans are being made, will be considerably better managed than in these other areas, or that the market and resource conditions are really more suitable, then the failure to develop competitive ability elsewhere should be counted as a weighty point against the candidate industry. An industry that would continue indefinitely to require coddling, in the form of subsidies from the government or in the form of import protection that permits it to charge the users of its product more than they would otherwise need to pay for equally good articles, would be a burden on the economy, and it would very likely handicap other industries by raising their costs.

Knowledge of the benefits derived and the difficulties encountered from the operation of a candidate industry in other areas should also be very useful in applying the tests which have been recommended in previous chapters. Knowledge of this kind should help in weighing the relative importance of two or more factors where one is favorable and another unfavorable. It should also call attention to errors and omissions in planning estimates.

In spite of diligent care in trying to foresee and examine all relevant aspects of a candidate industry when applying the various other tests, it is quite possible that some significant factor may have been overlooked. The problems of industry are so many and varied, and specific industries differ so much from each other in technical requirements and other peculiar features, that it is extremely difficult to foresee everything in the planning stage. Similarly, the relations among

Exhibit XIII-1

APPLYING THE TEST OF EXPERIENCE AND COMPETITION

In other areas not too dissimilar from the area for which an industrial program is being drawn up:

1. Has the candidate industry flourished? Or has it been undertaken with failure or indifferent success?

2. Has the candidate industry made a substantial contribution to the economic output and to the social progress of areas where it has been undertaken? Has it seemed to be more effective or less effective than other industries in stimulating other industries and other types of development?

3. Has the candidate industry been able to stand up to outside competition after a reasonable learning period? Or has it continued to be an "infant" for decades, requiring special protection which raises the cost of its products to consumers and to other industries?

industries and the effects of an industry or industry constellation upon the economy of an area are so complex that all the possibilities can seldom be anticipated. It is a great help, therefore, to study the experience with the industry in other areas.

Unfortunately, information concerning the industrial experience of newly developing areas is not readily available. Published material seldom provides the answers to the questions which have most concerned us in this Manual. Descriptions of the industries in some countries can be found, but they are usually at such a level of generality that they indicate nothing of the real operating problems that have arisen and nothing of the magnitude of benefits or difficulties. It will remain for the individual investigator, therefore, to find the cases which are most similar to the industrial projects which he is trying to evaluate and to collect what information he can from the business firms and government agencies involved.

A systematic tabulation of experience with selected industries in a number of newly developing areas would be an undertaking of considerable magnitude, if well done. But it would also be an extremely useful guide for those engaged in making economic development decisions. Perhaps through some group effort by interested parties or through organized support of a central research program such work could be undertaken and a source of reference material on industrial experience in developing areas could be built up.

Chapter XIV

COMBINING TEST RESULTS

The preceding chapters have recommended tests by which candidate industries may be rated with respect to various qualities that affect their suitability for the area being developed.

Suppose now that, after investigation, it appears that Industry A will bring a high direct net return, both in terms of private profit and in terms of the addition it will make to the national product. The industry appears to be about average in the stimulus it is likely to give to development of other industries and other sectors of the economy, promises to be reasonably stable and to have a good prospect for future growth, is a good foreign exchange earner, and rates well in social desirability. Industry B, the analysis indicates, promises a somewhat smaller rate of return on investment for the near future, so far as private profit is concerned, but would rate just as high as Industry A in net return from the national product point of view, because it will draw on labor that is now producing practically nothing. It suffers from some seasonable instability, seems to have exceptionally high growth prospects, promises to exert considerable developmental leverage as a stimulant to other industries and to agriculture, will make a slight net drain on foreign exchange resources, and is fairly good in social desirability. Similar analyses have been made of Industry C, D, E, and so on. How can an intelligent determination be made of the over-all advantage of certain industries as compared with certain others? Some excel on some tests, others on other tests.

There is no disguising the fact that the final selection among candidate industries will always require the exercise of types of judgment that cannot be reduced to precise calculations. There will always be many factors imperfectly known and many that cannot be precisely rated against each other. The problem can be compared to that of an explorer who has to choose a way for his party through a region of mountains and forests that has been only partly reconnoitered. Several ways may be possible—one short and hazardous, another arduous but fairly sure, and another seemingly very good but including certain sections that are unexplored. It is impossible to say that any one is best in all respects.

What we can hope to offer in this Manual, and what we have tried to offer, is not an infallible and automatic selection system, but merely a rational procedure for aiding the judgment. The preceding chapters

have set forth the important considerations that ought to be taken into account when choosing among candidate industries. We have suggested that at each step the merits of the candidate industries should be assessed on a comparative basis. In the case of the test of net return, it was recommended that the adjusted estimates reached by the methods described in Chapter VIII (estimates expressing the net return per unit of investment, from the national product point of view) be used to arrange the candidate industries in rank order—the industry that offers greatest net return to the economy per unit of investment at the top, and so on. For each of the other tests (described in Chapters IX to XIII) it was recommended that the comparative rating arrived at for each candidate be noted on a scale of 1 to 5, where 1 signifies very poor, 2 poor, 3 medium or average, 4 good, and 5 very good.

It remains now to combine the judgments reached in applying the various tests. A decision must be reached which selects some candidate industries as most suitable for the area, all things considered, while other candidate industries are rejected or postponed.

Exhibit XIV-1 is a suggested tabulation form to facilitate this final process of judgment. The candidate industries are to be listed on the left-hand side of the worksheet, arranged in the rank order assigned at the time of the preliminary evaluation of prospective net return. Then the results of the supplementary tests applied to each candidate industry are to be indicated in the six columns to the right of the industry names. If the candidate industry was rated 4 on the test assigned to the first column, this fact should be indicated by a single plus sign—as shown in Exhibit XIV-1 opposite "Industry S." This means that Industry S rated somewhat better than average on that particular test, and that this fact should tend to boost it a bit in the tentative ranking. If a candidate industry rated 5 on that test, it would receive a double plus in the appropriate column—as shown for Industry M. The minus sign in the "1st test" column after Industry K signifies that this candidate was rated 2 on the test, somewhat less than average, and that this tends to pull it down a bit in the tentative ranking. A score of 1 would be tabulated as a double minus. A score of 3 would appear as a plus and minus, as in the first column opposite Industry H, meaning that this rating tends neither to raise nor to lower the rank order of the candidate.

It is recommended that the column marked "1st test" be used to record the results of whichever supplementary test is deemed to be most important, in view of the particular circumstances and problems of the developing area. For example, in some areas this first position might clearly belong to "balance of payments effects." In others,

Exhibit XIV-1

FORM FOR TABULATING AND COMBINING RATINGS OF CANDIDATE INDUSTRIES

Tentative Ranking of Industries on Test of Net Return (National Product Viewpoint)	Results of Supplementary Tests*						Final Ranking
	1st Test	2nd Test	3rd Test	4th Test	5th Test	6th Test	
1. Industry S	+	±	-	±	±	∓	2
2. Industry M	++	++	±	±	+	+	1
3. Industry K	-	-	++	±	-	+	3
4. Industry H	±	±	+	-	+	-	4
5.							
6.							
etc.							

---

* Tabulate the results of the test regarded as the most important in the first column, the next most important in the second column, and so on. The order of importance of the tests will depend on the circumstances and problems of the area and will differ from area to area.

+ or ++ in a test column means that the industry was rated 4, good, or 5 very good on that test, which tends to move it upward in the ranking.

- or ∓ in a test column means that the industry was rated 2, poor, or 1, very poor on that test, which tends to move it downward in the ranking.

± in a test column means that the industry was rated 3, medium or average on that test, with no effect on the ranking.

where the pressure on the balance of payments is less acute and likely to remain less acute, but where there is a severe problem of seasonal and cyclical business fluctuations and unemployment, this first position might be given to "stability and growth." The tests should be assigned columns successively to the right, in the estimated order of their importance to the area concerned. Then, in the final appraisal, the plus and minus signs in the first few columns can be looked upon as more important than those in columns further to the right. In other words, this facilitates a rough weighting system.

Note that we do not recommend adding up the numerical rating scores for each industry, with or without some system of numerical weights. The reason is that this addition would give a fictitious appearance of precision which is not justified by the many nonquantitative judgments behind the ratings. The tests are interrelated, and no simple numerical summing-up could do justice to the complexities of the alternatives among which choices must be made. Furthermore, some test evaluations will be based on good, reliable data and others on scanty or unreliable data. We think it will be better to review each candidate industry (or industry group) carefully, letting the plus and minus marks call to mind the salient facts, favorable and unfavorable, which have been discovered in the course of the study of that industry's prospects in the developing area. Then, by a process of weighing one consideration against another (including the reliability of the data underlying each), some candidates will be shifted upward in the ranking, others downward. A column is provided at the right for working out and noting the revised order.

We have provided space for six supplementary tests, besides the basic test of net return to the economy (that is, net return from the national-product viewpoint) which determines the tentative ranking. This allows for noting the results of the tests of integrated development, stability and growth, balance of payments effects, social desirability, experience and competition, and also for noting what might be called "potential attractiveness to business enterprise." This last can be based on the calculation of net return from the business-enterprise viewpoint which was recommended in Chapter VIII as a step in arriving at net return to the economy. Net return from the business-enterprise viewpoint, as modified by such factors as stability of return, growth prospects, and the degree of risk believed to be involved because of conditions in the area or in the industry, is the basic test which will be applied by potential private investors whose capital and know-how could help to translate the industrial program into practical development. Therefore, a candidate industry which rates high on this test of attractiveness to business enterprise will

probably be easier to establish and expand in the area, with less cost to public agencies in subsidies and in time and trouble, than industries which rate lower. This is a substantial point in its favor, which should be taken into account along with other points in the final appraisal.

Once the many judgments involved in a final re-ranking of industries have been made and the new rank order has been noted, certain industries will stand at the top. It will now be necessary to determine how far down the rank-order list it is possible to go, in the near future, or within a certain period of years, in practical action designed to bring about the launching or the expansion of promising industries. The limit will be more or less flexible, but there will be some limit set by the availability of capital funds, the requirements of other parts of the development program, the number of capable managers available, the time that industrial development administrators can devote to various projects, and the interest that can be aroused on the part of private investors, domestic and foreign. Once a judgment has been reached on this question, a tentative "cut-off point" can be noted in the ranked list of industries, as far down the list as it seems wise to plan for practical action in the period for which the program is made. How far down the list this point will be located depends, of course, among other factors, on the amount of capital investment, skilled personnel, administrative time, etc. which the industries at the top of the list will require.

Some candidate industries will probably have been found to be quite hopeless, or at any rate relatively unpromising, for development in the area at its present stage in economic growth. They should be at the bottom of the list, or perhaps some of them have been scratched from the list entirely. In between the top and bottom group will be a number of candidate industries that, while not as promising as the first group for immediate development, seem to be next in line. Perhaps some of them will merit further consideration after the internal market has grown further, or after more persons have been trained in certain types of skills, or after other changes have occurred in the area's internal situation or in external factors affecting markets and competition.

Thus, the candidate industries can be separated into three classes:

Class A: The most promising industries (or groups of industries) for immediate development. First on the list for practical action.

Class B: The next most promising industries, or those likely to be most promising after some other developments have occurred. To be deferred.

Class C: Relatively unpromising industries. Rejected, at least for the time being. Possibly to be reconsidered if and when conditions change.

We have now completed the task undertaken in this Manual, which was to provide a set of criteria and a systematic procedure by which to select those industries for development in a less-industrialized area which are likely to contribute most to the area's economic advancement, as measured by the general income and living level of its people. The Manual will have served its purpose if it assists, in some degree, the many persons in many countries who are striving by hard work and intelligent foresight to make use of the productive possibilities of modern industry for building a better future.

APPENDIXES

(APPENDIX - A)

Appendix A

A COMPREHENSIVE CHECKLIST OF MANUFACTURING INDUSTRIES

The following checklist is presented as a useful tool in selection of candidate industries. It suggests the whole array of almost every conceivable type of modern manufacturing. By going through it selectively, a preliminary list of possibilities that seem to have at least some relevance to the circumstances of the developing area can be compiled. These can then be examined more closely, matching their characteristics against the area's demands and resources; and those industrial possibilities that appear promising enough to merit still more serious consideration become the candidate industries.

This checklist is based on the Standard Industrial Classification used by the United States Government for collecting manufacturing statistics. Adaptations have been made for present purposes, and some of the more detailed subdivisions have been omitted. The complete Standard Industrial Classification Manual, Volume I, Manufacturing Industries, may be obtained from the Superintendent of Documents, United States Government Printing Office, Washington 25, D. C. The price of "Part 1, Titles and Descriptions of Industries," published in November 1945, is $1.00 and of "Part 2, Alphabetic Index," published in December 1945, is $1.25. The code numbers in the following list are those of the principal industry groups in the Standard Industrial Classification.

20 FOOD AND KINDRED PRODUCTS

201 MEAT PRODUCTS
- Meat packing
- Sausages, sausage casings, and prepared meat products
- Poultry and small game dressing and packing

202 DAIRY PRODUCTS
- Creamery butter
- Natural cheese
- Condensed and evaporated milk
- Ice cream and ices
- Special dairy products, e.g. processed cheese and malted milk

203 CANNING AND PRESERVING FRUITS, VEGETABLES, AND SEA FOODS

Canned sea food
Cured fish
Canned fruits, vegetables, and soups; preserves, jams, and jellies
Dried and dehydrated fruits and vegetables
Pickled fruits and vegetables; vegetable sauces and seasonings; salad dressings
Frozen fruits, vegetables, and sea foods

204 GRAIN-MILL PRODUCTS

Flour and other grain-mill products, e.g. wheat flour, corn meal, and bran
Prepared feeds for animals and fowls
Cereal preparations
Rice cleaning and polishing
Blended and prepared flour

205 BAKERY PRODUCTS

Bread and perishable bakery products, e.g. doughnuts, cakes, pasteries
Biscuit, crackers, and pretzels

206 SUGAR

Cane sugar mills
Cane sugar refining
Beet sugar processing

207 CONFECTIONERY AND RELATED PRODUCTS

Candy and other confectionery products, e.g. chocolate-covered bars, candied fruits, processed nuts
Chocolate and cocoa products
Chewing gum

208 BEVERAGE INDUSTRIES

Bottled soft drinks and carbonated waters
Malt and malt liquors, e.g. beer and ale
Wines
Distilled, rectified, and blended liquors

209 MISCELLANEOUS FOOD PREPARATIONS AND KINDRED PRODUCTS

Baking powder, yeast, and other leavening compounds
Shortening and other cooking and edible fats and oils

209 MISCELLANEOUS FOOD PREPARATIONS AND KINDRED PRODUCTS (Continued)

Oleomargarine
Corn syrup, corn sugar, corn oil, and starch
Flavoring extracts and flavoring syrups
Vinegar and cider
Manufactured ice
Macaroni, spaghetti, vermicelli, and noodles
Other food preparations, e.g. cake fillings, sandwich spreads

21 TOBACCO MANUFACTURERS

211 CIGARETTES

212 CIGARS

213 TOBACCO (CHEWING AND SMOKING) AND SNUFF

214 TOBACCO STEMMING AND REDRYING

22 TEXTILE MILL PRODUCTS

221 SCOURING AND COMBING PLANTS

222 YARN AND THREAD MILLS (COTTON, WOOL, SILK, AND SYNTHETIC FIBER)

223 BROAD-WOVEN FABRIC MILLS (COTTON, WOOL, SILK, AND SYNTHETIC FIBER)

224 NARROW FABRICS AND OTHER SMALLWARES MILLS (COTTON, WOOL, SILK, AND SYNTHETIC FIBER)

Belting, webbing, ribbons, tapes, etc.

225 KNITTING MILLS

Full-fashioned hosiery mills
Seamless-hosiery mills
Knit outerwear and underwear mills
Knit gloves mills
Knit-fabric mills
Other knitting mills, e.g. curtains, washcloths, dishcloths and towels

226 DYEING AND FINISHING TEXTILES (EXCEPT KNIT GOODS)

227 CARPETS, RUGS, AND OTHER FLOOR COVERINGS
- Wool and fiber carpets, rugs, and carpet yarn
- Linoleum, asphalted-felt-base, and other hard-surface floor coverings

228 HATS (EXCEPT CLOTH AND MILLINERY)
- Fur-felt and wool-felt hats and hat bodies
- Straw hats
- Hatters' fur

229 MISCELLANEOUS TEXTILE GOODS
- Felt goods (except woven felts and hats)
- Lace goods
- Paddings and upholstery filling
- Processed waste and recovered fibers
- Artificial leather, oilcloth, and other impregnated and coated fabrics (except rubberized)
- Linen goods
- Jute goods
- Cordage and twine
- Other textile goods

23 APPAREL AND OTHER FINISHED PRODUCTS MADE FROM FABRICS AND SIMILAR MATERIALS

231 MEN'S, YOUTHS', AND BOYS' SUITS, COATS, AND OVERCOATS

232 MEN'S, YOUTHS', AND BOYS' FURNISHINGS, WORK CLOTHING, AND ALLIED GARMENTS
- Shirts (except work shirts), collars, and nightwear
- Underwear
- Neckwear
- Cloth hats and caps
- Hat and cap materials
- Separate trousers
- Work shirts
- Other, e.g. work and sport clothing

233 WOMEN'S AND MISSES' OUTERWEAR
- Blouses and waists
- Dresses
- Household apparel
- Suits, coats, and skirts
- Scarfs
- Other outerwear, e.g. bathing suits, sportswear

234 WOMEN'S, MISSES', CHILDREN'S, AND INFANTS' UNDER GARMENTS

Underwear and nightwear
Corsets and allied garments

235 MILLINERY

236 CHILDREN'S AND INFANTS' OUTERWEAR

Dresses
Coats
Other outerwear, e.g. playclothes

237 FUR GOODS

238 MISCELLANEOUS APPAREL AND ACCESSORIES

Dress and semidress gloves and mittens (fabric and leather combined)
Work gloves and mittens (fabric, fabric and leather combined)
Suspenders, garters, and related products
Robes and dressing gowns
Raincoats and other waterproof outer garments
Leather and sheep-lined clothing
Belts
Handkerchiefs
Other apparel, e.g. academic and theatrical

239 MISCELLANEOUS FABRICATED TEXTILE PRODUCTS

Curtains and draperies
Housefurnishings, e.g. sheets, pillowcases, blankets, tablecloths
Textile bags
Canvas products
Pleating, stitching, and tucking for the trade
Trimmings, stamped art goods, and art needlework
Embroideries
Other fabricated textile products, e.g. seat covers, flags

24 LUMBER AND WOOD PRODUCTS (EXCEPT FURNITURE)

241 LOGGING CAMPS AND LOGGING CONTRACTORS

242 SAWMILLS AND PLANING MILLS
- Sawmills and planing mills, general
- Veneer mills
- Shingle mills
- Cooperage stock mills
- Excelsior mills
- Other special-product sawmills

243 MILLWORK, PLYWOOD, AND PREFABRICATED STRUCTURAL WOOD PRODUCTS

244 WOODEN CONTAINERS
- Fruit and vegetable baskets
- Rattan and willowware (except furniture and fruit and vegetable baskets)
- Cigar boxes
- Wooden boxes (except cigar boxes)
- Cooperage, e.g. barrels, kegs, and pails

249 MISCELLANEOUS WOOD PRODUCTS
- Wood preserving
- Lasts and related products
- Mirror frames and picture frames
- Other wood products

25 FURNITURE AND FIXTURES

251 HOUSEHOLD FURNITURE
- Wood household furniture, not upholstered
- Wood household furniture, upholstered
- Reed and rattan furniture
- Metal household furniture
- Mattresses and bedsprings
- Other household furniture

252 OFFICE FURNITURE - WOOD AND METAL

253 PUBLIC-BUILDING AND PROFESSIONAL FURNITURE
- School furniture, theater seats, laboratory, and hospital furniture, and similar products

254 PARTITIONS, SHELVING, LOCKERS, AND OFFICE AND STORE FIXTURES

256 WINDOW AND DOOR SCREENS, SHADES, AND VENETIAN BLINDS

259 MISCELLANEOUS FURNITURE AND FIXTURES
- Restaurant furniture
- Other furniture and fixtures

26 PAPER AND ALLIED PRODUCTS

261 PULP, PAPER, AND PAPERBOARD MILLS

264 PAPER COATING AND GLAZING

265 ENVELOPES

266 PAPER BAGS

267 PAPERBOARD CONTAINERS AND BOXES
- Paperboard boxes—folded, set-up, and corrugated
- Fiber cans, tubes, drums, and similar products

269 PULP GOODS AND MISCELLANEOUS CONVERTED PAPER PRODUCTS
- Die-cut paper, paperboard, and cardboard, e.g. index cards, paper bottle caps, photograph folders
- Wallpaper
- Pulp goods, pressed and molded, e.g. plates
- Other converted paper products, e.g. napkins, towels, cups, toilet paper

27 PRINTING, PUBLISHING, AND ALLIED INDUSTRIES

271 NEWSPAPERS

272 PERIODICALS

273 BOOKS

274 MISCELLANEOUS PUBLISHING

275 COMMERCIAL PRINTING

276 LITHOGRAPHING

277 GREETING CARDS

278 BOOKBINDING AND RELATED INDUSTRIES
- Bookbinding
- Blankbook making and paper ruling
- Library and loose-leaf binder manufacturing
- Miscellaneous work related to bookbinding

279 SERVICE INDUSTRIES FOR THE PRINTING TRADE
- Typesetting
- Engraving and plate printing
- Photoengraving
- Electrotyping and stereotyping

28 CHEMICALS AND ALLIED PRODUCTS

281 INDUSTRIAL INORGANIC CHEMICALS
- Sulfuric acid
- Alkalies and chlorine
- Other industrial inorganic chemicals, e.g. fertilizer materials, many acids, salts, and other compounds

282 INDUSTRIAL ORGANIC CHEMICALS
- Cyclic (coal-tar) crudes
- Intermediates, dyes, color lakes, and toners
- Plastics materials and elastomers
- Synthetic rubber
- Synthetic fibers
- Explosives
- Other industrial organic chemicals, e.g. organic acids, solvents, plasticizers

283 DRUGS AND MEDICINES
- Biological products
- Botanical products
- Inorganic and organic medicinal chemicals
- Pharmaceutical preparations

284 SOAP AND GLYCERIN, CLEANING AND POLISHING PREPARATIONS, AND SULFONATED OILS AND ASSISTANTS

285 PAINTS, VARNISHES, LACQUERS, JAPANS, AND ENAMELS; INORGANIC COLOR PIGMENTS, WHITING, AND WOOD FILLERS

286 GUM AND WOOD CHEMICALS
- Hardwood distillation
- Softwood distillation

286 GUM AND WOOD CHEMICALS (Continued)
- Gum naval stores
- Natural dyeing materials
- Natural tanning materials

287 FERTILIZERS
- Fertilizers (manufacturing and mixing)
- Fertilizers (mixing only)

288 VEGETABLE AND ANIMAL OILS AND FATS
- Cottonseed oil mills
- Linseed oil mills
- Soybean oil mills
- Other vegetable oil mills, e.g. castor, cocoanut
- Marine animal oils
- Grease and tallow
- Fatty acids
- Other animal oils

289 MISCELLANEOUS CHEMICALS, INCLUDING INDUSTRIAL CHEMICAL PRODUCTS AND PREPARATIONS
- Printing ink
- Essential oils
- Perfumes, cosmetics, and other toilet preparations
- Glue and gelatin
- Bone black, carbon black, and lamp black
- Compressed and liquified gases
- Insecticides and fungicides
- Salt
- Other chemicals and chemical products, e.g. writing inks, deodorants, adhesives

29 PRODUCTS OF PETROLEUM AND COAL

291 PETROLEUM REFINING

293 COKE AND BY-PRODUCTS
- Beehive coke ovens
- By-product coke ovens

295 PAVING AND ROOFING MATERIALS
- Paving mixtures and blocks
- Roofing felts and coatings

299 MISCELLANEOUS PRODUCTS OF PETROLEUM AND COAL
- Fuel briquets and packaged fuel
- Lubricating oils and greases not made in petroleum refineries
- Other products of petroleum and coal

30 RUBBER PRODUCTS

301 TIRES AND INNER TUBES

302 RUBBER FOOTWEAR

303 RECLAIMED RUBBER

309 OTHER RUBBER GOODS
Rubberized fabrics and clothing, industrial and mechanical rubber goods, rubber specialties, and sundries, etc.

31 LEATHER AND LEATHER PRODUCTS

311 LEATHER—TANNED, CURRIED, AND FINISHED

312 INDUSTRIAL LEATHER BELTING AND PACKING

313 BOOT AND SHOE CUT STOCK AND FINDINGS

314 FOOTWEAR (EXCEPT RUBBER)

315 LEATHER GLOVES AND MITTENS
Dress and semidress leather gloves
Leather work gloves and mittens

316 LUGGAGE
Suitcases, briefcases, bags, trunks, and other luggage

317 HANDBAGS AND SMALL LEATHER GOODS
Women's handbags and purses
Small leather goods
Saddlery, harness, and whips
Other leather goods, e. g. dog furnishings, desk sets, novelties

32 STONE, CLAY, AND GLASS PRODUCTS

321 FLAT GLASS

322 GLASS AND GLASSWARE, PRESSED OR BLOWN
Glass containers
Other pressed and blown glass and glassware, e. g. tableware, cooking wear, light bulbs, lenses for lamps

323 GLASS PRODUCTS MADE OF PURCHASED GLASS

Stained glass, safety glass, mirrors, watch crystals, ground glass, etc.

324 CEMENT, HYDRAULIC

325 STRUCTURAL CLAY PRODUCTS

Brick and hollow tile
Floor and wall tile
Sewer pipe
Clay refractories
Other structural clay products, e.g. roofing tile, flue lining, promenade tile

326 POTTERY AND RELATED PRODUCTS

Vitreous and semivitreous plumbing fixtures
Vitreous-china table and kitchen articles
Fine earthenware (whiteware) table and kitchen articles
Porcelain electrical supplies
China decorating for the trade
Other pottery products, e.g. vases, lamp bases, flower pots, laboratory ware

327 CONCRETE, GYPSUM, AND PLASTER PRODUCTS

Concrete products, e.g. building blocks and shapes, pipe, poles, piling
Gypsum products, e.g. plaster and plasterboard
Lime
Mineral wool

328 CUT-STONE AND STONE PRODUCTS

329 ABRASIVE, ASBESTOS, AND MISCELLANEOUS NONMETALLIC MINERAL PRODUCTS

Abrasive products
Asbestos products
Steam and other packing, and pipe and boiler covering
Natural graphite—ground, refined, or blended
Minerals and earths—ground or otherwise treated
Sand-lime brick, block, and tile
Nonclay refractories
Statuary and art goods (factory production)

33 PRIMARY METAL INDUSTRIES

331 BLAST FURNACES, STEEL WORKS, AND ROLLING MILLS
- Blast furnaces
- Steel works and rolling mills
- Electrometallurgical products

332 IRON AND STEEL FOUNDRIES
- Gray-iron
- Malleable-iron
- Steel

333 PRIMARY SMELTING AND REFINING OF NONFERROUS METALS
- Primary smelting and refining copper, lead, zinc, aluminum, magnesium, gold, silver, nickel, tin, etc.

334 SECONDARY SMELTING AND REFINING OF NONFERROUS METALS AND ALLOYS
- Recovery of nonferrous metals and alloys from scrap and dross

335 ROLLING, DRAWING, AND ALLOYING OF NONFERROUS METALS
- Plates, sheets, strips, rods, wire, tubing

336 NONFERROUS FOUNDRIES

339 MISCELLANEOUS PRIMARY METAL INDUSTRIES
- Iron and steel forgings
- Wire drawing
- Welded and heavy-riveted pipe
- Other primary metal industries, e.g. razor blade steel, cold-rolled sheets

34 FABRICATED METAL PRODUCTS (EXCEPT ORDNANCE, MACHINERY AND TRANSPORTATION EQUIPMENT)

341 TIN CANS AND OTHER TINWARE

342 CUTLERY, HAND TOOLS, AND GENERAL HARDWARE

Cutlery
Edge tools
Files
Hand saws and saw blades
Other hand tools
Other hardware, e.g. builders, motor vehicle and suitcase hardware

343 HEATING APPARATUS (EXCEPT ELECTRIC AND PLUMBERS' SUPPLIES)

Enameled-iron and metal sanitary ware and other plumbers' supplies
Oil burners, domestic and industrial
Heating and cooking apparatus, e.g. stoves (except electric), water heaters, radiators, steam tables

344 FABRICATED STRUCTURAL METAL PRODUCTS

Fabricated structural steel and ornamental metal work
Metal doors, sash, frames, molding, and trim
Boiler shop products
Sheet-metal work

346 METAL STAMPING, COATING, AND ENGRAVING

Vitreous-enameled products
Automobile stampings
Other stamped and pressed metal products
Powder metallurgy
Enameling, japanning, and lacquering
Galvanizing and other hot-dip coating
Engraving on metal
Electroplating, plating, and polishing

347 LIGHTING FIXTURES

348 FABRICATED WIRE PRODUCTS

Nails and spikes
Other wirework, e.g. fencing, wire cable, screens, guards, grills

349 MISCELLANEOUS FABRICATED METAL PRODUCTS

Metal shipping barrels, drums, kegs, and pails
Safes and vaults
Steel springs
Bolts, nuts, washers, and rivets
Screw-machine products
Collapsible tubes
Gold, silver, tin, aluminum, and other foil
Other fabricated metal products, e.g. novelties and specialties

35 MACHINERY (EXCEPT ELECTRICAL)

351 ENGINES AND TURBINES

Steam engines, turbines, and water wheels
Diesel and semidiesel engines
Other internal-combustion engines, except aircraft or automobile engines

352 AGRICULTURAL MACHINERY AND TRACTORS

353 CONSTRUCTION AND MINING MACHINERY AND EQUIPMENT

Construction, mining, and similar machinery
Oil-field machinery and tools

354 METALWORKING MACHINERY

Machine tools
Metalworking machinery (except machine tools)
Machine-tool accessories, other metalworking-machinery accessories, and machinists' precision tools

355 SPECIAL-INDUSTRY MACHINERY (EXCEPT METALWORKING MACHINERY)

Food-products machinery
Textile machinery
Woodworking machinery
Paper-industries machinery
Printing-trades machinery
Other special-industry machinery, e.g. leather-working, glass-making, clay-working

356 GENERAL INDUSTRIAL MACHINERY AND EQUIPMENT

Pumps, air and gas compressors, and pumping equipment
Elevators and escalators
Conveyors and conveying equipment
Blowers, exhaust and ventilating fans
Industrial trucks, tractors, trailers, and stackers
Mechanical power-transmission equipment (except ball and roller bearings)
Industrial furnaces and ovens
Mechanical stokers, domestic and industrial
Other general industrial machinery and equipment

357 OFFICE AND STORE MACHINES AND DEVICES

Computing machines and cash registers
Typewriters
Vending, amusement, and other coin-operated machines
Scales and balances
Other office and store machines and devices, e.g. mimeographing, addressing

358 SERVICE-INDUSTRY AND HOUSEHOLD MACHINES

Domestic laundry equipment
Commercial laundry, dry-cleaning, and pressing machines
Sewing machines
Vacuum cleaners
Refrigerators, refrigeration machinery, and complete air-conditioning units
Measuring-and-dispensing pumps
Other service-industry and household machines

359 MISCELLANEOUS MACHINERY PARTS

Valves and fittings (except plumbers' valves)
Fabricated pipe and fittings
Ball and roller bearings
Machine shops (jobbing and repair)

36 ELECTRICAL MACHINERY, EQUIPMENT, AND SUPPLIES

361 ELECTRICAL GENERATING, TRANSMISSION, DISTRIBUTION, AND INDUSTRIAL APPARATUS

Wiring devices and supplies
Carbon and graphite products for use in the electrical industry

361 ELECTRICAL GENERATING, TRANSMISSION, DISTRIBUTION, AND INDUSTRIAL APPARATUS (Continued)

Instruments for indicating, measuring, and recording electrical quantities and characteristics
Motors, generators, and motor-generator sets
Power and distribution transformers
Switchgear, switchboard apparatus, and industrial controls
Electrical welding apparatus
Other electrical equipment for industrial use, e.g. electric heating units

362 ELECTRICAL APPLIANCES

Electric ranges, hot plates, irons, fans, etc.

363 INSULATED WIRE AND CABLE

364 ELECTRICAL EQUIPMENT FOR MOTOR VEHICLES, AIRCRAFT, AND RAILWAY LOCOMOTIVES AND CARS

365 ELECTRIC LAMPS

366 COMMUNICATION EQUIPMENT AND RELATED PRODUCTS

Radios, radio and television equipment, radar and related detection apparatus, and phonographs
Radio tubes
Phonograph records
Telephone and telegraph equipment
Other communication equipment, e.g. signals, alarms, traffic and railroad devices

369 MISCELLANEOUS ELECTRICAL PRODUCTS

Storage batteries
Primary batteries (dry and wet)
X-ray and therapeutic apparatus and nonradio electronic tubes
Other electrical products, e.g. hearing aids, extension cords, Christmas tree outfits

37 TRANSPORTATION EQUIPMENT

371 MOTOR VEHICLES AND MOTOR-VEHICLE EQUIPMENT

Motor vehicles
Passenger-car bodies
Truck and bus bodies

371 MOTOR VEHICLES AND MOTOR-VEHICLE EQUIPMENT (Continued)

Motor-vehicle parts and accessories
Truck trailers
Automobile trailers (for attachment to passenger cars)

372 AIRCRAFT AND PARTS

Aircraft
Aircraft engines and engine parts
Aircraft propellers and propeller parts
Aircraft parts and auxiliary equipment

373 SHIP AND BOAT BUILDING AND REPAIRING

374 RAILROAD EQUIPMENT

Locomotives and parts
Railroad and street cars

375 MOTORCYCLES, BICYCLES, AND PARTS

379 OTHER TRANSPORTATION EQUIPMENT

Farm wagons, wheelbarrows, pushcarts, etc.

38 PROFESSIONAL, SCIENTIFIC, AND CONTROLLING INSTRUMENTS, PHOTOGRAPHIC AND OPTICAL GOODS, WATCHES AND CLOCKS

381 LABORATORY, SCIENTIFIC, AND ENGINEERING INSTRUMENTS (EXCEPT SURGICAL, MEDICAL, AND DENTAL)

382 MECHANICAL MEASURING AND CONTROLLING INSTRUMENTS

383 OPTICAL INSTRUMENTS AND LENSES

384 SURGICAL, MEDICAL, AND DENTAL INSTRUMENTS AND SUPPLIES

Surgical and medical instruments
Surgical and orthopedic appliances and supplies
Dental equipment and supplies

385 OPHTHALMIC GOODS

386 PHOTOGRAPHIC EQUIPMENT AND SUPPLIES

387 WATCHES, CLOCKS, CLOCKWORK-OPERATED DEVICES, AND PARTS
- Watches, clocks, and parts
- Watchcases

39 MISCELLANEOUS MANUFACTURING INDUSTRIES

391 JEWELRY, SILVERWARE AND PLATED WARE
- Jewelry (precious metal)
- Jeweler's findings and materials
- Lapidary work
- Silverware and plated ware

393 MUSICAL INSTRUMENTS AND PARTS
- Pianos
- Organs
- Piano and organ parts and materials
- All other musical instruments, parts, and materials

394 TOYS AND SPORTING AND ATHLETIC GOODS
- Games and toys
- Dolls
- Children's vehicles
- Sporting and athletic goods

395 PENS, PENCILS, AND OTHER OFFICE AND ARTISTS' MATERIALS
- Pens, mechanical pencils, and pen points
- Lead pencils and crayons
- Hand stamps, stencils, and brands
- Artists' materials
- Carbon paper and inked ribbons

396 COSTUME JEWELRY, COSTUME NOVELTIES, BUTTONS, AND MISCELLANEOUS NOTIONS
- Costume jewelry and costume novelties
- Feathers, plumes, and artificial flowers
- Buttons
- Needles, pins, hooks and eyes, and similar notions

397 FABRICATED PLASTICS PRODUCTS

398 - 399

MISCELLANEOUS MANUFACTURING INDUSTRIES

Brooms and brushes
Cork products
Matches
Candles
Fireworks and pyrotechnics
Jewelry cases and instrument cases
Lamp shades
Morticians' goods
Beauty-shop and barber-shop equipment
Furs, dressed and dyed
Signs and advertising displays
Hair work
Umbrellas, parasols, and canes
Tobacco pipes and cigarette holders
Soda-fountain and beer-dispensing equipment
Models and patterns
Miscellaneous fabricated products

(APPENDIX - B)

TABLE OF CONTENTS

Section		Page
	Introduction	1
I	Food Canning Industry	7
II	Can Manufacturing	21
III	Plastics Products	33
IV	Cement Industry	47
V	Bottled Soft Drink Industry	59
VI	Rubber Products	71

LIST OF FIGURES

I	Architecture of the Enameled Sanitary Tin Can	25
II	Sanitary Can Line Flow Chart	26
III	Manufacture of Portland Cement	51
IV	Carbonated Beverage Bottling Plant Flow Chart	62

Appendix B

INDUSTRY PROFILES

INTRODUCTION

Purpose of Industry Profiles

The procedure recommended in this Manual for selecting the manufacturing industries most suitable for development in a country (or other area) involves two stages.

First, the demands and resources in the area, or those available to it from outside, are surveyed. These demands and resources are matched in a preliminary way against the products, the feasible scales of operation, and the resource requirements of each industry on a comprehensive list. This list includes, of course, all those lines of manufacturing in which some interest has been shown in the area or which for one reason or another appear promising. The result of this first stage is the selection of a much more limited list of industries which seem to have the best chance to succeed and to contribute to the development of the area. This smaller group then becomes the "candidate industries."

The second stage in the selection process is a more thorough study of the candidate industries, in relation to the area's demands and resources. Certain tests discussed in the Manual are applied to each industry, or in appropriate cases to groups of industries. Those that show the most promise on these tests are then chosen for the intensive practical work of planning and promotion which must precede the launching of a new undertaking.

The purpose of the preliminary screening which results in the list of candidate industries is to eliminate from consideration as early as possible those industries which are clearly unsuited to the area at its current stage of development or which offer relatively little promise of successful operation. This avoids the expenditure of time and money in detailed study of industries which are not good candidates. Even this first screening, however, requires a wide range of information about each of many different industries.

The second screening requires even more precise and detailed information about each of the candidate industries, as well as about the industrial demands and resources of the area itself. Are the

techniques of production in the industry adaptable, without resulting in intolerably high costs per unit of output, to operation on a scale which the probable market demand can support? What kinds of marketing facilities are necessary? What kinds of raw materials does the industry require? How important is low-cost fuel or power? Water supply? Special managerial skills and technically trained personnel? Skilled foremen? Cost of machinery and equipment? Facilities for repairs? Does the industry require relatively heavy investment of capital in proportion to its output?

Search of the literature on the subject has failed to reveal sources of information from which persons engaged in carrying out the selection process could readily obtain the needed data on industry characteristics. Each industry has an extensive technical literature of its own, which is something of a labyrinth for anyone not very familiar with the industry. The study of each of a considerable number of industries in order to pick out the salient characteristics which determine whether or not they should be seriously considered for a given area is very time-consuming. This is true even if the research is carried out where there are excellent libraries of industrial economics and engineering, and where specialists in each industry can be consulted. The industrially less-developed areas, which need the information most, do not have such facilities. Industrial engineers, equipment manufacturers, and similar sources of information are generally specialized in one or a few lines of manufacturing. They are most useful at a later stage in planning new industries, after preliminary selections have been made by tests and comparisons which require knowledge of a wider range of industries. There is even some danger that unwise selections of industries might be made or better opportunities overlooked because of the enthusiasm or promoting skill of someone especially interested in a particular type of industry.

Therefore, we have attempted in this Appendix to do two things:

1. Provide examples of the kind of industry information most needed in making either preliminary or final decisions on the suitability of a particular line of manufacturing for a developing area. These examples will serve as patterns or models to suggest the kinds of questions that have to be asked about other industries and the types of information sources that should be consulted.

2. Provide, for a few industries, concrete descriptions of their market and resource requirements, together with indications of good sources of further information. In the one year available for preparation of this Manual, and in view of expense limitations, we

have been able to prepare only eight of these "industry profiles." We suggest that if the profiles offered here seem to fill a real need, a much larger number should be prepared. Perhaps they should be compiled in the form of a loose-leaf industrial development handbook to which supplements could be added from time to time. This is an undertaking which might well be considered jointly by representatives of countries especially concerned with industrial development possibilities.

Form of Industry Profiles

In the profiles which follow, the information concerning each industry is presented under a series of topic headings relating to the principal features and requirements of the industry and its place in a developing economy. The following topics appear in each profile to facilitate the comparison of industries:

Products of the Industry
Organization and Structure of the Industry
The Market
Quality Standards
Competition
Marketing Facilities Required
Size of Plant
Raw Materials and Supplies
Machinery and Equipment
Energy Requirements
Buildings and Utilities
Personnel
Supporting Services
Key Location Factors
Role in Integrated Development
Stability
Balance of Payments Effects (Imports vs. Exports)
Social Aspects
Experience in Newly Developing Areas
Sources of Additional Information

Sources and Coverage of Data

Data in the industry profiles have been assembled from a variety of sources. Much general information has come from published material—engineering manuals, text books, general reference works, and publications of trade associations, industrial firms, and agencies of various governments. The same information about an industry is frequently found in several of these sources, and no attempt to credit individual sources has been made, except in the case of direct

quotations or material which appears to be unique. Trade associations have added valuable comments, by correspondence, to data contained in their printed materials. Members of existing firms in the industries have supplied information in personal interviews, as have members of firms supplying equipment to the industries, and industry specialists in the United States Department of Commerce. Stanford Research Institute staff members with special knowledge of certain industries have given their assistance. Persons in trade associations, existing firms, and equipment supply firms have read drafts of the profiles and offered suggestions and additional information. The assistance of all those who have contributed to these profiles is gratefully acknowledged.

The data given in the profiles are drawn largely from conditions and experience in the United States. The organization of the industries described, the processes, and the prices found in other industrial countries are often, of course, somewhat different. It would be highly desirable, though it was not possible within the time and expense limitations of this Manual, to draw upon the industrial experience of a variety of countries, including some of the newly developing countries, in sketching the characteristics of each industry. An attempt has been made to include data for small-scale operations wherever possible, even though small-scale operations may not be typical of the industry in the United States.

Cost estimates for machinery and equipment apply to new machinery purchased in the United States. Used equipment may often be purchased at very much lower prices. Sometimes machinery which is no longer economical in the United States because it requires more labor than later models may be satisfactory in areas with lower wage rates. Competent engineering advice as to the suitability and the condition of used machinery should, of course, be obtained. Wage rates are likely to rise as an area develops and productivity increases. In fact, this must happen if development succeeds in its purpose of raising the general level of living. This should be considered in selecting equipment, lest a newly established plant which depends too much on low wage rates be rendered uneconomical rather quickly.

The requirements of the various industries with respect to labor, technical personnel, and management have been difficult to express satisfactorily. "Unskilled labor," for example, in different countries may refer to persons with widely varying education, dexterity, and work habits, making it difficult to find a common denominator which will describe the actual working abilities represented. With respect to supervisory, technical, and management skills the knowledge and abilities which come from experience in an industry—the "know-how"—

are often difficult to describe, but very important. We have tried to give some indication in the profiles of the requirements of different industries in these respects.

I. FOOD CANNING INDUSTRY

Products

The preservation of foods in hermetically sealed containers by sterilization with heat is called canning. The process is adaptable to a wide range of fruits and vegetables. Local crops and market preferences will indicate the most promising products. Compound foods, such as soups, may be canned following the same basic process outlined for fruits and vegetables. The canning of fish and meats is also similar to the processes discussed here, with obvious differences in the preparation stages. More than 400 different foods and combinations are canned.

Properly canned food is equal in nutritive value to the same food cooked in other ways.

Organization and Structure of the Industry

In the United States canning is not an integrated industry, in that it is not common for canners to grow the crops which they pack, although it is done to a limited extent. Rather, the crops are purchased from independent growers in the vicinity of the cannery. Different arrangements may be found desirable in other countries. (See discussion of raw materials following.)

Ready-made cans are purchased from can manufacturing companies, although in a country in which the industry is not highly developed it may be necessary for the canner to provide his own cans.

Canned goods may be sold under the canner's own brands or they may be sold to distributors and labeled in accordance with the distributor's instructions.

The Market

Canned goods are sold in two main types of market and must be prepared with the requirements of these markets in mind.

Market for Household Consumption. For family use a product must be packed in a can of appropriate size. Different products are packed in different-sized cans with this requirement in mind. For example, only a small quantity of pimientos is usually needed at one time, as opposed to relatively larger amounts of peaches, beans, etc.

The flavor, syrup, and method of preparation should be those best adapted to home-cooking methods in general use by the potential consumers.

The relative cost of canned foods and fresh foods will vary with local conditions such as urbanization, transportation, state of development of the canning industry, and traditional marketing margins. In the United States the special handling needed to distribute fresh products in good condition frequently makes canned goods cheaper to the consumer than unprocessed foods. In other countries the canned products may be luxury-priced items. Where consumers are not accustomed to canned foods they may not be well received even at favorable prices. Food habits change slowly and must be considered in appraising the market. If the climate makes fresh fruits and vegetables available the year round, it may be difficult to develop a market for the canned product. Urban groups, apartment dwellers, and housewives working outside the home are likely to be among the most receptive buyers.

In the household market, brand preferences are usually well developed. In the United States some canners sell under their own brands, which are advertised directly to consumers and sold to the grocery trade by the canner's salesmen. Many leading brands have been established by wholesalers and retailers, who shop among canners for the particular packs having qualities best suited to their brands. Such distributors are able to maintain uniform quality in their brand in spite of fluctuations in the quality of output at any one cannery. The pattern of brand ownership which develops in a country will reflect local conditions in the trade.

The Institutional Market. Substantial quantities of canned goods are purchased by military forces, hospitals, schools, restaurants, bakeries, etc. A large can is commonly desired, and the style of pack may be different from that suited to general household use (special fruits for pies, etc.). Price and quality considerations are more important than brand preferences in this market.

An additional market for canned goods, which might be called an industrial market, exists for certain specialties which are canned with a view to further processing at a later date. For example, the various fruits in a fruit salad mix may not be available at the same time and same place for canning in one operation. It is a common practice to pack a fruit in large cans for later mixing with other fruits to make a new canned product. Fruits or fruit pulp may be canned for later use in making jams and jellies. The existence of

this market in a given country will depend on tastes for mixed products and the development of subsequent processing operations.

Quality Standards

The maintenance of satisfactory quality in the product is vital to the success of a canning industry in any country. Attempts to force the consumption of an inferior product through severely restricting imports are likely to fail and will not provide the basis for real development in the local industry.

There are many aspects to the quality of any canned food. They include the basic requirements of sanitation, freedom from adulteration and spoilage, proper filling of containers, identification of contents, and the elements of flavor, color, size of pieces, sugar content, etc. In the United States certain minimum standards are enforced by the federal and state governments. In addition, canners may voluntarily submit to continuous inspection by representatives of the United States Department of Agriculture for the purpose of showing on their labels an official quality grade. The owners of premium quality brands strive to maintain a high standard in their products to protect their reputations in the market. Professional and trade associations have programs for improving quality in their respective fields of activity.

Standards for sanitation, weights and measures, adulteration, and similar factors are of universal applicability and can be readily determined. Flavors, desired maturity of fruit, color, syrup, etc. are largely subjective in nature, and preferences vary from place to place. It has been the practice in the United States to apply proposed standards for a test period and to hold public hearings before making a standard official. For subjective qualities such as flavor, color, etc. each country may wish to work out its own standards, but the official standards and experience of the United States might be useful in this program, which should be begun at an early stage in the development of the industry. The principal federal agencies regulating this industry in the United States are the United States Department of Agriculture, United States Public Health Service, and the United States Food and Durg Administration.

Competition

If imported canned goods are being consumed in a country it is likely that strong brand preferences have been built up in the household consumer market. Even with a product of equal quality the new canner may find it difficult to enter the market with a new brand. If the import

brands are owned by local importers rather than foreign suppliers there is the possibility of selling a locally packed product to the brand owner and affixing his label. The institutional market is likely to be less influenced by brands, but established trade connections may be difficult to overcome. These aspects of the market should be carefully evaluated in planning a cannery.

Marketing Facilities

Canned foods are not perishable, and do not require the special handing facilities necessary for perishable foods. If the canner sells to distributors and applies their brand labels his marketing arrangements are simple. Canners in the United States rely heavily on brokers to sell in this manner, but in a country where the industry is not highly developed such specialists are likely to be neither available nor necessary. Direct contact with a limited number of buyers will be possible. If the canner sells under his own brand, an advertising and sales staff will be required.

In packing a crop a canner rapidly makes a heavy investment in an inventory of finished goods. If the crop is seasonal, so that a year's supply must be packed in a short period, this financing problem is intensified. Arrangements, such as public warehousing, under which the inventory may be used as security for loan to provide working capital are desirable.

Quality standards, as discussed above, are an important aspect of marketing. They make it possible to buy and sell canned goods on the basis of standard grades with confidence in the uniformity of a given lot. Due to variations in the quality of raw material received from growers it is not possible for the canner to produce a uniform quality in his entire pack. Effective marketing requires, even in the absence of official grading regulations, that he separate the pack into lots within which the quality is fairly uniform. This is necessary to maintain the reputation of brands and to assure the consumer that a given can may be duplicated on the next purchase.

The price of canned goods is sensitive to changes in the quantity of the product placed on the market. If more of a product is canned than the market can absorb at reasonable prices the canners may be in serious financial difficulties. In a bumper crop year competing canners taking advantage of the raw material supply may produce a total pack larger than the market can absorb. This problem has been recognized for many years in the United States, and a system of marketing agreements in which representatives of growers, canners, and

government determine the total quantity to be packed, has been worked out for many crops. Such a system protects the interests of growers and consumers as well as those of the canners.

Manufacturing Process

The canning process is basically quite simple, but careful attention to detail to insure that each step is properly carried out is essential to a good product.

The first step in canning is the receipt of the raw material at the cannery and its preparation for the can. This includes thorough cleaning and washing, peeling, coring, trimming, shelling, etc., as required for the particular product, and the sorting and grading necessary to secure uniform material. This grading is very important in determining the quality of the product. Depending on the crop being handled, preparation may also include blanching the material in steam or hot water.

Properly prepared and sorted material is next placed in clean cans and the cans are then filled with hot brine or sugar syrup.

The next step is to exhaust gases from the product and eliminate air in the head space of the can prior to sealing. This is accomplished by holding the filled cans for a time in a bath of steam or hot water, after which the step of hermetically sealing the can is immediately performed. Some products do not require exhausting, particularly those preheated or cooked before filling. Sealing is a precision mechanical process in which the machinery must be carefully adjusted. A proper seal is vital to the preservation of the product.

Sealed cans are next heat processed to sterilize the contents. Times and temperatures required vary with the nature of the product and the size of the cans. Highly acid foods are more easily sterilized than low-acid foods and may be processed by boiling in open kettles. Low-acid foods are nearly always sterilized by cooking with steam under pressure in a closed retort. High altitudes, of course, limit the temperature which can be reached in an open kettle. This step is the most critical of all in determining the quality of the canned product, since understerilization permits spoilage, and overtreating harms textures, colors, and flavors.

After heat processing, most products are quickly cooled in water or air to check the action of heat. After cooling the cans are ready for labeling, casing, and storage.

Cleanliness is essential in any food-processing plant, and at the end of each work period the equipment must be scrubbed and steamed free of all food residue and left as dry as possible. Steam and water under pressure of at least 50 to 60 pounds per square inch are necessary for efficient general cleanup. Sanitation, including insect and rodent control, is a full-time function.

Size of Plant

The essential canning operations may be carried out on scales ranging from household kitchens to large, fully mechanized canneries. Machinery to prepare a product for the can, i. e. for cleaning, washing, peeling, pitting, coring, trimming, sizing, etc., is highly specialized according to the material to be handled. Production models of such equipment in the United States have large capacity, usually ranging upwards of one ton of output per hour. Handwork may be substituted for machinery in preparing the material if labor is inexpensive, and output capacity can then be varied over a wide range.

In a commercial operation the difficulties in handling manually a hot, open can filled with liquid seem to indicate that machinery for the addition of syrup or brine, exhausting the can, and sealing the can are practical necessities. The need for precision in closing the can is also better served by mechanical rather than hand-operated devices. This is general-purpose equipment which can be used with a variety of products. The smallest combination of syruper, exhauster, and can closer (double seamer) regularly available in the United States would be capable of handling up to thirty #2 cans per minute and would represent an investment of about $6,000.

Equipment for heat processing may be either for batch or continuous processing and is available in a wide range of sizes.

Labeling, casing, and subsequent handling may be done manually on any scale or with machinery in large plants. The cost of labor is the principal determinant of the method used.

Machinery and Equipment

The machinery and equipment used in a cannery can vary over a wide range. (See Size of Plant.) Equipment suppliers will design a complete cannery of any desired size for any desired product and furnish all or part of the equipment. Their advice and price quotations should be sought. It is common in the United States to purchase only the more complex machines, while the canner builds on his own premises the simpler components of the line.

In addition to mechanical efficiency two important points must be considered in the design and construction of canning equipment. The design must allow for easy cleaning with steam and hot water. The materials used must not contaminate the food and must resist corrosion. To illustrate the latter point, contact with iron in the later stages of canning will darken beets; minute traces of copper will seriously darken corn; and copper must be avoided with products in which ascorbic acid is of nutritional significance because it has a catalytic action on the oxidation of this vitamin. For these reasons stainless steel is widely used in canning equipment.

Minimum mechanical equipment for a commercial cannery probably consists of a small syruper, an exhauster, and a double seamer for closing cans. These units would be coupled together so that hot cans are not handled manually until they have been sealed. The cost of this equipment in the United States would be about $6,000. A cooker is essential. For foods which can be processed at atmospheric pressure a simple open kettle suffices. A steam boiler of some 60- to 100-boiler horsepower is required. Tables and tanks for washing the raw material and preparing it for the cans, and pipes, pumps, and tanks needed for water, steam, syrup, and brine complete the layout. Materials may be moved manually from one station to another if labor is not expensive.

A United States canning machinery manufacturer recently designed a small general-purpose cannery to handle fruit and juices and also to cook jams. It would handle peaches, pears, plums, cherries, guavas, apricots, tomatoes, and berries; and contained several pieces of specialized washing and pitting equipment for these fruits. Conveyor belts and packing tables for the raw material were included, as was a complete set of juice-extracting and handling equipment, jam kettles, a continuous type of atmospheric cooker and can cooler, control instruments, stainless steel piping, motors, and spare parts. This installation would handle about sixty #2 cans of fruit per minute. It would cost about $100,000 F.O.B. United States ports. The necessary steam boiler is not included.

A United States manufacturer recently designed a small, fully mechanized line for canning guava pulp in #10 cans (3 quarts) at the rate of 17 cans per minute. The complete line including motors and control equipment, but not including steam boiler and piping, would cost about $25,000 F.O.B. United States ports. This is a specialized installation and would not have much flexibility for other products. A pineapple cannery for slices and juice capable of handling 10 pineapples per minute and with enough capacity in the filling and cooking equipment for future expansion was similarly planned for an estimated cost of $45,000. Mechanical conveyors and steam boiler are not included in this price.

Raw Materials and Supplies

The raw material for canning is the food crop which is being packed. A very wide range of fruits and vegetables may be successfully canned. Certain general considerations apply to all of them.

The material received from the field has a very important influence on the quality of the final product, and the canner must assure himself of a satisfactory supply. In fruits only certain varieties of a given species will be found suitable for canning. This factor is usually less critical in vegetables but still affects the quality of the canned product. In countries with a highly developed canning industry much research has been done in developing varieties with desirable canning characteristics. Where the industry is just starting attention should be given to the selection of varieties best suited to the soil, climate, and canning requirements of the area.

Proper degree of maturity of the crop at harvest is important. Material should be in the can as quickly as possible after harvest, except that it may be possible to ripen certain fruits in storage. Most vegetables should be canned within a few hours of harvest. Maturity and perishability create problems in timing the harvest to avoid overloading the cannery and problems in rapid transportation from field to cannery.

To meet the problems just mentioned in providing a food crop for canning requires a high degree of coordination between the growers and the canners. It has become a general practice in the United States for canners to contract with growers for annually planted crops in advance of planting. Variety, time of planting, cultural and harvest conditions, grading procedure, and approximate price may be agreed upon at that time. Tree crops and perennials are usually contracted for at some time during the growing season, or agreements may cover a period of years.

The principal problem in supplies for a cannery arises in connection with the containers used. Empty containers cannot be economically shipped for any great distance, which is perhaps the most serious limiting factor on this important item. Independent can manufacturing companies have located plants near the areas in which a substantial volume of canning is done. With a new canning industry the supply of cans becomes an important consideration. (See discussion of the Can Manufacturing Industry.) Glass containers can be used, but they usually prove somewhat more expensive than tin cans and entail more difficult problems of handling and securing a satisfactory seal.

Other supplies required are simple, consisting largely of salt, sugar, cleaning compounds, etc. Uniform quality in ingredients going into the pack is important.

Energy Requirements

Although steam is required for numerous uses in a cannery, a small, low-pressure boiler is adequate. Such a boiler can be adapted to various fuels depending on supplies in the area of use. The electric motors for a fully mechanized small cannery would probably not total more than 25 to 30 horsepower.

Building and Utilities

Building. The machinery for the small general-purpose cannery described previously under Machinery and Equipment requires about 8,000 square feet of floor space, while the pineapple and guava pulp lines described there could be accommodated in about 2,500 square feet. In addition there must be a boiler room, shipping and receiving docks, storage space for supplies and finished goods, office, locker rooms, etc. Construction must withstand moisture and provide drainage for large amounts of cleaning water. All parts of the cannery property should be designed to promote sanitation and the control of insects and rodents.

Water. Requirements probably will range from three to five gallons for every #2 can of fruit or vegetable packed. Boiler and cooling water should be reasonably free from scale-forming and corrosive chemicals. Hard water has objectionable effects on some products when used for blanching, soaking, or making brine for filling cans. Other products are improved by the presence of moderate hardness in the water. All water in the cannery should be of good sanitary quality to avoid contamination of food. A dual water system in which less pure water is provided for certain purposes creates difficult problems for control and should be avoided. Equipment for purifying or softening water may be required, and this problem should be considered carefully in planning a cannery.

Waste Disposal. The large volume of waste water from a cannery is rich in soluble and suspended organic matter. These wastes do not transmit disease and are not a health problem, but the oxidation of organic materials consumes oxygen in the water. This can constitute a problem if the receiving body of water is not large enough to absorb these wastes without serious oxygen depletion. Fish can be suffocated by oxygen depletion, and if all oxygen is removed from the water a septic condition with foul odors and darkening water results. Unless a

large body of water is available to receive cannery wastes some form of treatment before discharge from the cannery may be required.

Electricity. Required for driving mechanized canning equipment. (See Energy Requirements preceding.)

Personnel

Labor. There should be at least one person with sufficient mechanical skill to adjust, service, and repair the machinery and equipment. Supervisors must understand the need for sanitation and regard for quality of material packed, and be vigilant in enforcing these requirements. A relatively large number of unskilled workers is required. Preparing the material and filling the cans is light work commonly performed by women.

Technical. There should be at least one person with an understanding of the principles of the canning process and a knowledge of the effects of changes in materials, exhaust time, cooking time, temperature, etc. In addition, the ability to recognize the desirable taste and other quality characteristics of the product is required. A person with some grounding in basic science should be able to acquire the necessary knowledge through working in the canning industry, in an area where it is relatively advanced, for a few months and thereafter using available literature to increase his knowledge. A cannery should not be started without some person who has had some practical experience and training in a well-run cannery. Although large canneries maintain testing laboratories to assist in quality control and improvement, this should not be necessary at the start of a small operation.

Management. With reference to production, attention to detail by a manager who knows and appreciates food, and who will take the trouble to determine and enforce the procedures required for a good product in his plant is essential. This person may well provide the knowledge discussed under Personnel--Technical. The amount of management time which must be spent on marketing depends on the marketing channels used and the local situation. An adequate study of market possibilities before starting a cannery and an appreciation of selling problems is essential. (See The Market; Quality Standards; Competition preceding.)

Supporting Services

In the United States the canning industry has the support of many research services provided by governments, universities, can manufacturers, canners, and equipment suppliers. A new canner in another

country can draw on the large volume of published material which has resulted from this work. He can also consult the advisory staffs of equipment suppliers. Problems peculiar to the country will arise, and special research would be desirable on these problems. However, the industry can be started without waiting for such investigative and research facilities to develop.

Key Location Factors

Due to the perishability of its raw material the cannery tends to locate close to the source of the food crops it packs. In an area with highly developed transportation services to bring fresh fruits and vegetables to the cannery there is greater flexibility in location, and a point close to a supply of seasonal labor may be selected.

Role in Integrated Development

In an area in which food production is seasonal in nature the preservation of food for out-of-season consumption is an important factor in raising the level of living. Distribution of canned foods can be accomplished with much less labor than is required for fresh produce, particularly where large urban areas are concerned. Seasonal employment for women in canneries may be an important supplement to incomes and may utilize a portion of the labor force which would not otherwise engage in commercial employment. The industry creates a demand for crop seed, seasonings, printed labels, cartons, cans, and other supplies, thus stimulating other activity.

Stability

If canned foods are comparable in price to other foods, they share in the general stability of the food industries during cyclical economic fluctuations. If canned food is in the luxury category, it may be expected to show considerable response to cyclical changes in consumer incomes. The individual cannery conducts its operations to correspond to the crop harvest. In temperate climates this usually means that the cannery operates for only a few weeks each year unless several crops with different seasons can be handled. Baked beans, soups, meats, etc. may be canned practically the year round.

Balance of Payments Effects

If locally canned products can compete effectively with imported ones the balance of payments effects should be quite favorable, because of the relatively large portion of the value of the product which is

attributable to local produce and local labor. Otherwise the balance of payments effects may be unfavorable because imports of machinery and tin plate will be required in a country just starting the industry. There is a possibility of developing exports of standard items in competition with other areas, and also of introducing the area's own special food products (tropical fruits, for example) into export markets.

Social Effects

The canning industry should have generally favorable social effects in raising the level of living, improving nutrition, providing supplementary seasonal income for women workers, etc. In some situations a waste disposal problem can develop. (See Buildings and Utilities preceding.)

Experience in Newly Developing Areas

The canning of meat for export is highly developed in Uruguay and Argentina. Pineapple is canned for export in the Philippines by a subsidiary of an American company, but pineapple canning in Cuba has not been very successful, primarily because of inferior quality control in the product. There has been great growth in the canning of fruits in Australia and South Africa in recent years for export to the United Kingdom. This trade depends on sterling area restrictions for its existence, because California fruits could enter the market at lower prices in spite of existing tariffs.

Canning and preserving for local consumption is carried on to some extent in many of the industrially less-developed areas, including Latin America. In general, there has been insufficient emphasis on quality, and the products have not been able to compete with imports except with the aid of trade restrictions. High prices have discouraged the consumption of canned goods, especially when coupled with poor quality.

SOURCES OF ADDITIONAL INFORMATION

Books, Pamphlets, Periodicals

A Complete Course in Canning, 7th ed., The Canning Trade, 20 South Gay Street, Baltimore 2, Maryland, 1946.

Almanac of the Canning Industry, annually, The Canning Trade, 20 South Gay Street, Baltimore 2, Maryland, $2.00. Compilation of pack and crop statistics, price ranges, food laws and regulations, United States grades for quality determination, and other reference data. Buyers' guide section lists by product manufacturer of canning machinery and supplies.

Bitting, A. W., Appertizing, or The Art of Canning; Its History and Development. Trade Pressroom, San Francisco, 1937. $7.50. (Available through Food Machinery and Chemical Corporation, San Jose, California. Title stems from Nicholas Appert, who developed the modern process of canning.)

Campbell's Book: Canning, Preserving, and Pickling, rev. by W. A. Maclinn and R. A. Isker, Vance Publishing Corporation, Chicago, 1950.

Canned Food Reference Manual, 3d ed., American Can Company. New York, 1949.

Cruess, W. V., Commercial Fruit and Vegetable Products, 3d ed., McGraw-Hill, New York, 1948.

Food Engineering, monthly, 330 West 42nd Street, New York 36, New York.

Jacobs, Morris B., ed., The Chemistry and Technology of Food and Food Products, 2d ed., Interscience Publishers, Incorporated, New York, 1951. 3 volumes, $15.

Processes for Low-Acid Canned Foods in Metal Containers, 6th ed., National Canners Association, Bulletin 26L, Washington, D. C., 1946.

The Canner, weekly, 105 W. Adams Street, Chicago 3, Illinois.

The Canning Trade, weekly, 20 South Gay Street, Baltimore 2, Maryland.

The Food Packer, monthly, 139 N. Clark Street, Chicago 2, Illinois.

Sanitation for the Food-Preservation Industries, prepared by the Association of Food Industry Sanitarians, Incorporated, McGraw-Hill, New York, 1952.

Western Canner and Packer, monthly, 121 Second Street, San Francisco 5, California.

Trade Associations

National Canners Association, 1133 20th Street, N. W., Washington 6, D. C. Covers the food canning field, specializing in scientific laboratory research and statistics of the industry.

National Preservers Association, 839-17th Street, Washington 6, D. C. Membership includes manufacturers of preserves, jellies, fruit butters, and related products.

Canners League of California, 215 Market Street, San Francisco 9, California. Canners of fruits and vegetables.

Canning Machinery and Supplies Association, 4360 Montgomery Avenue, Suite 2, Washington 14, D. C. A manufacturers association.

II. CAN MANUFACTURING

Products

Products of the can manufacturing industry include a wide variety of containers, ranging from simple slip-cover cans, such as are used for biscuits and other dry products, friction-top cans for paints, etc., to sanitary fruit and vegetable cans, vacuum coffee cans, beer cans, and other precision-made containers. Cans are produced in a great many sizes and shapes to meet the needs of the different products to be packed. Some can companies in the United States produce other items as well, including fiber drums, bottle caps, pails, and kitchenware.

Other light gauge sheet metal products may be made using basic can-making equipment, for example, tin cups, perforated cylinders for oil filter cartridges, etc.

Organization and Structure of the Industry

Typical can manufacturers in the United States perform all operations required to fabricate a finished container but are not integrated vertically with sources of raw material or users of containers. The industry in the United States includes companies of all sizes from giant corporations to shops employing only three or four persons. The large companies produce a full line of can sizes and types, while the small ones tend to specialize in a few products. Small shops can compete effectively in the production of specialty items in which production runs are short. Some users of small quantities of specialty items make their own containers. In a few cases very large users of standard cans, such as soup cans, have their own large-scale can manufacturing plants.

A few United States can manufacturers have branches or affiliates in numerous other countries. Under this arrangement they are able to supply essential technical assistance required in starting a large-scale can line.

The Market

The demand for cans arises entirely from the producers of items requiring packaging, and cans are therefore sold in the industrial market. A can manufacturer is not concerned with selling to household consumers, but the large companies in the United States engage in advertising to consumers to promote the general use of canned products.

Appraisal of the market for cans in a given country will consist of determining the existence of other industries making a product suitable for canning and in evaluating the potential volume of their output in cans. Some industries, such as food canning, necessarily rely on cans; and the initiation of the industry and the can supply facilities must be undertaken together. Other industries have a wider choice of containers and may be found already in existence but not using cans. In tropical climates the quality of many dry foodstuffs is much better preserved in cans than in other containers, and the can might be introduced even if the cost is higher. In recent years many products not previously canned have come to rely heavily on the tin container, and some imagination and foresight will be required to evaluate the potential uses in a given country. In some areas a tin container has a considerable re-use value to consumers of the packaged product.

Quality Standards

A can must be adequate to contain and protect the product packed in it. The great variety of products which may be canned allows a corresponding variety in the quality and precision of the cans. A non-airtight and nonwatertight can for dry products is relatively easy to make and has no exacting standards. On the other hand, the sanitary food can, which will be hermetically sealed, must be made with great precision to insure the airtight seal, and for some products it must be carefully enameled with a properly selected coating. A beer can or aerosol container, which must withstand considerable pressure, is an even more exacting product.

Cans which must be airtight should be tested as they are completed. Machinery for automatically testing cans under air pressure and rejecting faulty cans is considered an essential part of a modern line for airtight containers. If manufacture of airtight cans must be undertaken on a small scale this equipment will be too large and expensive for use, and cans must be tested individually in hand-operated machines. In such a situation statistical quality control methods based on testing samples might be employed in the interest of economy.

The can manufacturer should confine his output to those types in which he can maintain satisfactory quality. Use of a can which is inadequate in design, materials, or construction will soon discredit the manufacturer and perhaps even the idea of using the tin container.

Competition

Competition in the industry may be of two types. The first is competition with other containers. The necessity of evaluating the relative advantages and costs of cans and other packaging was mentioned previously under The Market.

The second type of competition in this industry arises when more than one manufacturer is producing the same kind of can. Foreign producers will usually not be competitive in this respect in spite of the highly developed can industry in many countries, since the transportation costs on empty containers are usually an effective bar to imports. However, there is a real possibility of competition from other local manufacturers. The alternative methods of manufacture, which are described in Manufacturing Processes following, must be carefully appraised to insure selection of the one which is most economical under local conditions. Quality of product and service to customers are important competitive aspects of the industry.

In the United States many of the firms making cans do not compete directly with one another because each specializes on particular can types. Unless large-volume production is required for one type and size, the large company producing a great variety of cans has no particular advantage over the small shop. Small plants in the United States handle many of the specialty items produced in small quantities.

Marketing Facilities Required

Cans will be sold by the manufacturer's salesmen directly to industrial users. The size and composition of the sales force will depend on the number of potential users. In areas in which cans are not widely used a major part of the selling effort may be directed toward persuading those firms now using other containers to using cans. Some technical knowledge which will enable the salesmen to evaluate the packaging requirements of various products is highly desirable. A number of United States can companies have extensive organizations for supplying technical services to customers on a consulting basis.

Transportation of large volumes of light weight is required in the distribution of finished cans. Transport costs will limit the area which may be economically served by a given can manufacturing establishment. To preserve cleanliness the empty cans are usually shipped in cartons or in trucks or box cars lined with paper.

Manufacturing Processes

The following discussion concerns the manufacture of open-top packers' cans, which are cylindrical sanitary food cans such as are commonly used for fruits and vegetables. These cans consist of three parts—the body and two ends. The bottom is attached at the factory, and the top is shipped separately to the user for attachment after the can is filled. Figure 1 illustrates the construction of such a can. There are four methods which might be used to produce cans in a country starting this industry.

1. Automatic Can Line. Sheets of tin plate are passed through slitters, which cut them into rectangular "body blanks." These blanks are then fed into the automatic machinery which notches the corners, folds hooks on the ends, forms the cylindrical body, closes the side seam, solders the side seam, wipes off excess solder, cools the body, flanges the ends of the completed cylinder, attaches the bottom, and air-tests the can for leaks. The ends are punched out of strips of tin plate in an automatic punch press, their edges curled, and a ribbon of sealing compound applied around the edges. A special machine dries this compound, and the ends are complete. Modern can lines operate with a speed of 300 to 450 cans per minute. Figure 2 illustrates the sequence of operations.

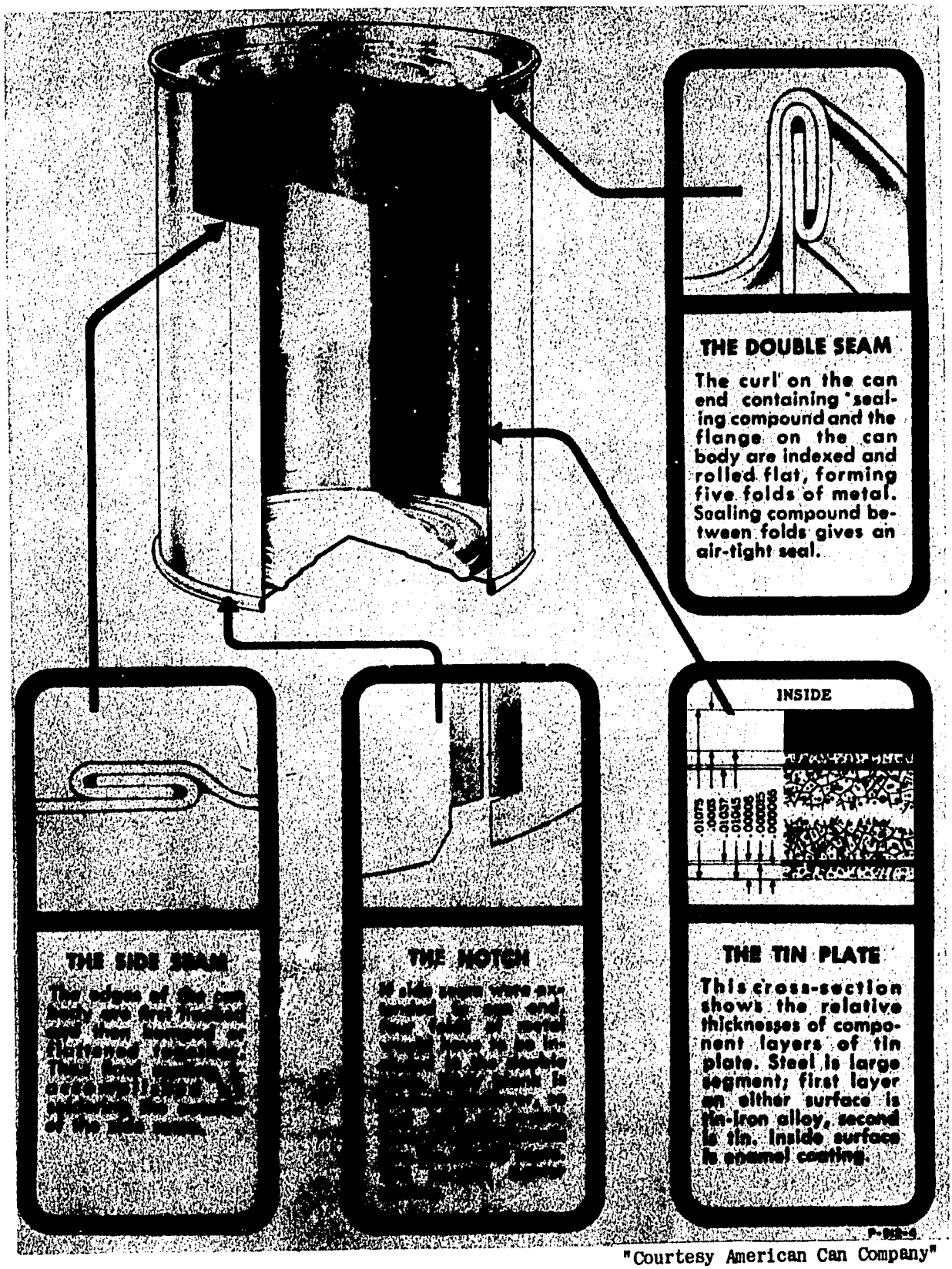
2. Semiautomatic and Hand-Operated Machinery. The same steps described for the automatic can line may be performed on a series of separate machines. Such machines may be fed by hand, with materials carried from one work station to another on a moving belt, by gravity chutes, or even in boxes. Soldering is the most difficult step in hand operations, and airtight cans cannot be produced without skilled workers. A wide range of nonairtight cans may be readily produced by hand, however. The semiautomatic-body machine handles the soldering operation mechanically. Airtight cans for lard, oil, paint, etc. can be made easily, using side seam cement instead of solder.

3. Partial Manufacturing. It is possible to purchase can ends ready-made from manufacturers in the United States or elsewhere. Shipment of the flat ends is economical, and the need for several pieces of machinery is eliminated. The body could be made locally by one of the methods described above. For small-scale operations it is probable that ends could be purchased more cheaply than they could be made locally.

4. Re-Forming and Assembly. It is possible to buy can bodies, as well as ends, from the large can manufacturers. The bodies are

FIGURE I

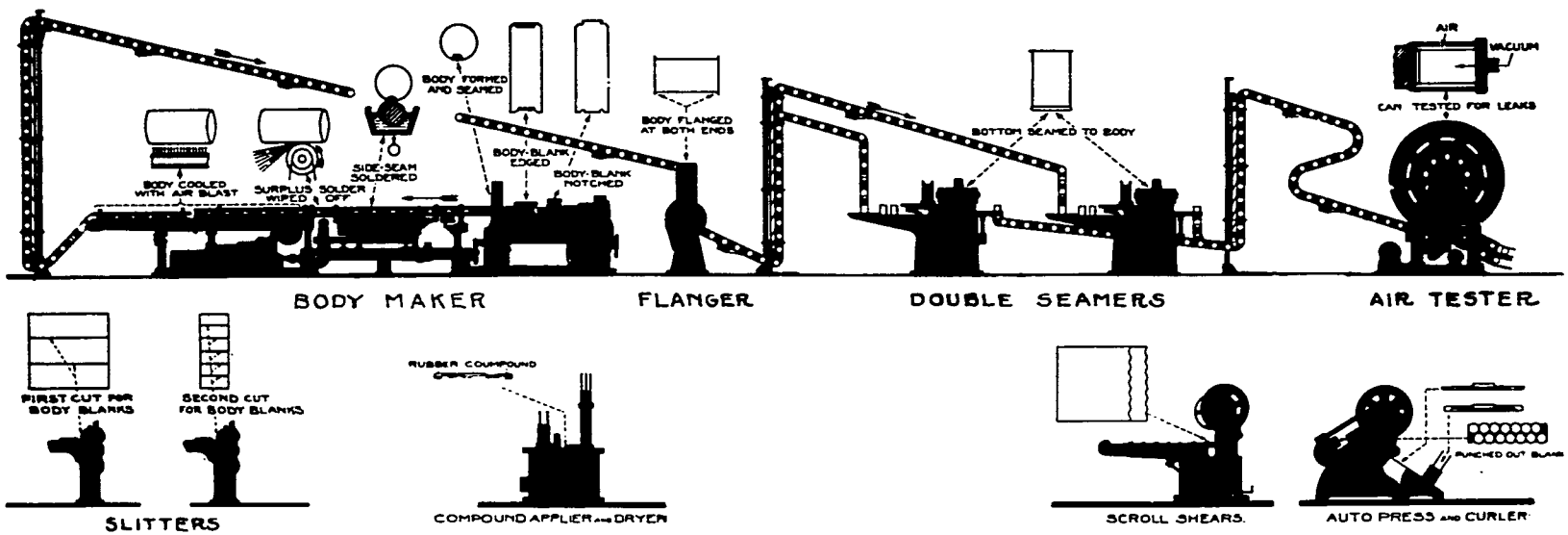
ARCHITECTURE OF THE ENAMELED SANITARY TIN CAN



"Courtesy American Can Company"

FIGURE 2

SANITARY CAN LINE
FLOW CHART



Reproduced with the consent of Continental Can Company.

A-912-2

flattened for shipment, which makes long-distance transportation economically feasible. The body is re-formed into cylindrical shape; its ends are flanged; and the bottom is attached. This method requires minimum equipment and could be carried on with only one skilled man in the plant. The soldering operation is not required. This method is used at Alaskan salmon canneries, on ships canning fish afloat, and in areas where small canning operations are carried on. The cans are made on the cannery premises, thus avoiding packing, warehousing, and shipping finished cans. Such savings help make this method economical.

Size of Plant

The automatic can line is a large-scale operation, which is capable of producing up to 450 finished cans a minute. A given line has some flexibility as to size of can produced. For example, diameters between 2-1/8 and 4-1/4 inches and a considerably wider range of heights could be handled by one line, although a cost of about $20,000 would be entailed for the necessary adapters for each size produced. The production run of any one size should be large to keep the setup time from being too costly. New equipment for a modern automatic can line would cost about $250,000 in the United States. Machinery with lower rates of output is available at lower prices. When large volume and precision work are required the automatic can line may be considered a virtual necessity.

Plants using nonautomatic machinery, to produce by one of the methods described under Manufacturing Processes, may be set up for a wide range of outputs. By utilizing simple, and perhaps secondhand, machinery the investment may be kept small so that maximum rates of output for even that machinery do not become essential for economical operation.

Raw Materials and Supplies

The principal raw material for cans is sheet steel, usually with a thin coating of tin or tin alloy. The thickness and composition of the steel and the coating vary with the use to which the cans will be put. Can manufacturers purchase tin plate from steel mills, where it is made by high-speed, mass-production methods. The equipment and skills required restrict tin plate production to advanced steel industries.

If enameled cans are required, the enamel is applied to the tin plate by the can manufacturer before can parts are cut. Some of the

smaller companies in the United States have enameling done outside their plants either by independent firms, the steel companies, or other can manufacturers, thus eliminating investment in an enamel coater and oven. The type of enamel used varies with the nature of the products to be canned. Enamel is usually baked onto the sheets. If ends for airtight cans are made, sealing compound for the edges is required. Tin solder, lead, and soldering flux are also required in substantial quantity.

The materials required are in forms permitting economical transportation and should pose no special problems for the industry even if imported.

No special supplies other than those usually required in factory operations are required—lubricants, cleansers, abrasives, rags, etc.

Machinery and Equipment

Due to the variety of ways in which a can shop may be equipped and the wide range of output rates which are possible, only the most general indication of the necessary machinery and its approximate cost can be given.

An automatic can line consists of a series of specialized machines coupled together with conveying and control devices to perform in sequence the steps required in can manufacture. (See Manufacturing Processes and Size of Plant for description.) A high-speed line in the 400-cans-per-minute category would cost new in the United States about $250,000. For lower output rates the cost would be less. Used equipment is available at lower prices for moderate rates of output.

If all parts of the can are to be manufactured using nonautomatic machinery a wide range of equipment can be used, depending on the rate of output and type of can required. A shop for making sanitary food cans using semiautomatic, hand-operated machinery turning out five to ten cans per minute could be equipped for about $15,000 in the United States. If used machinery were purchased, the cost would be somewhat less. Simpler types of cans may be produced on less expensive equipment.

In making airtight cans, if the ends are purchased ready-made from another manufacturer a considerable reduction in machinery is possible. The punch press and dies, edge curler, sealing compound applicator, and drier would not be required.

If the process used is that of re-forming and assembly of ready-made bodies and ends, the equipment requirements are reduced to a minimum. Only machines to re-form the body, flange the body, and apply the bottom are necessary. Machinery of this sort capable of turning out about five cans per minute could be obtained in the United States for about $1,200. Much higher output rates can be achieved with this process using automatic machinery costing about $12,000. These figures do not include testing equipment.

Energy Requirements

Electric power is required for the motors and controls on an automatic can line. Nonautomatic machinery can be powered with individual electric motors or with a shaft and belt system using a central power source. Total power required for an automatic can line is about 30 to 40 horsepower, and a small shop with semiautomatic machines could be run with 10 to 15 horsepower.

Buildings and Utilities

The machinery of an automatic can line occupies floor space approximately 15 x 120 feet. The press line to make can ends requires space about 10 x 40 feet. A building about 75 x 150 feet would adequately house this equipment and provide for the necessary auxiliary spaces. If a large inventory of finished cans is to be accumulated in advance of a peak season, more space would be necessary. A small shop using hand-operated and semiautomatic equipment could be housed in 4,000 to 5,000 square feet of floor space.

Personnel

Labor. An automatic can line is precision equipment of a high order and needs to be adjusted with the accuracy of a watch. It requires the supervision of expert mechanics. For one line two semi-skilled operators and one highly skilled maintenance man would be needed on each shift, plus labor for handling materials, office help, etc.

In a re-forming and assembly operation which could turn out about five cans per minute, only three machine operators are necessary, plus some help for moving the materials from one machine to the next, to storage, etc. With automatic equipment for this process, two persons, only one of whom need be highly skilled, are needed for one line.

In a plant using nonautomatic machinery one or two skilled mechanics with experience in the industry could set up the machines and keep them in adjustment. Operatives could be locally trained. If hand-soldering is done, as for an airtight can, it requires very substantial skill.

Technical. The services of engineers and technicans with experience in the industry should be utilized in planning a can-manufacturing operation and in meeting the problems associated with materials and designs needed for the local products to be canned. Large can manufacturers employ many engineers, chemists, metallurgists, food technologists, etc. to work continually on improving cans and methods and to design cans to handle new products.

A new manufacturer would require access to such services. Large United States can companies supply technical assistance to branches, affiliates, and customers in many other countries.

Management. Special management skills in this industry include an appreciation of the precision and skills required on the production line and a knowledge of the applications of metal containers in the packaging of a variety of products. In a small nonautomatic plant the manager may combine in himself the mechanical skills and technical knowledge needed for the production operations.

Supporting Services

An automatic can line will require technical assistance and repair services which are beyond the capacity of a new manufacturer to provide for himself. Arrangements with a machinery supplier or large can company may fill this need. (See Personnel, Technical for mention of this point.)

Key Location Factors

The difficulty and cost of shipping finished containers over long distances makes this industry strongly oriented toward its markets. Large can companies operate many plants in order to have producing facilities near the points of heavy consumption.

Role in Integrated Development

A supply of cans is essential to the development of a food-canning industry and may be found to facilitate the local processing of products such as guava pulp, etc. which cannot be shipped in perishable form.

Availability of containers will also facilitate the local manufacture of imported raw materials in lieu of imported finished products, e.g. local mixing and packaging of paint from bulk raw materials.

Stability

Problems of storing empty containers tend to make production in the can industry follow closely the fluctuations in production of the industries using cans. By producing more than one type of can or by selling to industries in which the seasonal patterns do not coincide, the can manufacturer may be able to achieve a measure of seasonal stability. Can-ends may be made in the off-peak season and easily stored. This practice helps to provide steady employment for a nucleus of key employees.

Balance of Payments Effects

The can industry will probably require the importation of machinery and raw materials, causing an unfavorable balance of payments for the industry itself. The important consideration, however, is the over-all effect of the can industry and the industries which use the cans. Through the can-using industries some imports may be replaced and some new exports may be possible.

Social Aspects

A can plant has no undesirable social aspects, and the use of canned products is generally associated with an improving level of living.

Experience in Newly Developing Areas

A large pineapple cannery in the Philippines recently installed its own automatic can line. However, technical assistance and maintenance are being provided by an American can company.

SOURCES OF ADDITIONAL INFORMATION

Books, Pamphlets, Periodicals

There is no trade magazine or newspaper in the United States devoted exclusively to can manufacturing, but the following are of general interest to the industry.

Almanac of the Canning Industry, annually, The Canning Trade, 20 South Gay Street, Baltimore, Maryland. A one-volume encyclopedia of statistics and other information about canning and cans.

Cans for Fruits and Vegetables. Simplified Practice Recommendations, United States Bureau of Standards. Obtainable from United States Government Printing Office, Washington, D. C.

Food Engineering, monthly, 330 West 42nd Street, New York 36, New York.

Modern Packaging, monthly, 575 Madison Avenue, New York 22, New York.

Packaging Parade, monthly, 22 East Huron Street, Chicago 11, Illinois.

The Canned Food Reference Manual, 3d ed., American Can Company, New York, 1949. Has chapters on tin plate and can manufacture.

The Cannery, weekly, 105 West Adams Street, Chicago 3, Illinois.

The Canning Trade, weekly, 20 South Gay Street, Baltimore 2, Maryland.

The Food Packer, monthly, 139 North Clark Street, Chicago 2, Illinois.

Tin Plate and Tin Cans in the United States, Bulletin #4, of the International Tin Research and Development Council. Published in England, 1936. Probably the only book devoted in large part to the technical side of can making in the United States.

Trade Associations

Can Manufacturers Institute, Incorporated, 60 East 42nd Street, New York 17, New York.

III. PLASTICS PRODUCTS

Products

Plastics are synthetic materials made from organic chemicals and capable of being formed into a wide variety of articles.

Industrial Products. The major application of plastics in a manufacturing community is in making parts of finished products or subassemblies. These are supplied to other manufacturers, who in turn put them into consumers' goods. Examples:

Clock cases
Radio cabinets
Housings for scales, instruments, switches, etc.
Parts for electrical equipment of many kinds
Closures for containers
Handles for utensils, tools, cabinets
Gears, bearings, pulleys, and casters
Knobs and dials
Buttons and buckles
Molding, gaskets, and trim of many kinds
Tubing
Pen and pencil barrels
Optical frames
Lighting fixtures
Instrument panel assemblies
Wire insulation
Shoe soles
Film for rainwear, curtains, covers, packaging, etc.
Monofilaments for insect screens, upholstery fabrics, etc.
Containers—jars, vials, squeeze bottles, cases, boxes, compartmented trays, etc.
Structural panels and sheets
Floor and wall tile
Vehicle bodies and boat hulls
Furniture parts
Tanks

Consumer Products. Final consumer products account for less volume than industrial items in industrial countries, but would be possibly the major type of plastics products in newly developing areas.

Examples:

Combs
Novelty jewelry
Toys
Games—dominoes, chess sets, etc.
Dishes, utensils, trays, and tumblers
Coat hangers
Rain coats, curtains, draperies, upholstery, etc.
Belts
Garden hose

Organization and Structure of the Industry

There are two distinct divisions of the plastics industry:

1. The manufacture of the plastics materials, principally resins, from basic raw materials—coal, salt, lime, water, natural gas, petroleum, sulfur, and cellulose. This is a complex chemical process suitable only for large-scale, highly developed chemical plants requiring heavy investment and advanced technology. Resins are marketed as intermediate materials such as powders, liquids, and pellets. Primary producers also sell plastics in standard forms such as sheets, rods, tubes, etc. This part of the industry becomes feasible only after a large chemical industry has been developed and is not considered further in this profile.

2. The formation of plastics materials into consumer and industrial products by a variety of processes which are described below. At least 5,000 companies are engaged in this work in the United States. This division of the industry is the subject of this profile.

The Market

Demand is for the functional articles made from plastics rather than from plastics as such. Hence there is the market for combs, the market for dishes, the market for radio cabinets, etc. In many cases the plastic article competes with similar articles made from other materials, and the share of the market which can be captured by the plastic must be estimated. The manufacturer may sell articles of his own design directly to the trade, or he may do custom work in which he produces items designed by others and sold by them under their names. By combining in one shop the production of several items a custom molder can economically operate a plant which is too expensive for any one product to support. Existing manufacturers and distributors of articles, which could be made wholly or partly of plastics, are an important market for the custom molder, extruder, or fabricator.

Quality Standards

Selection of proper material for a plastic article in view of its design and intended use is essential. Use of the wrong material, with consequent unsatisfactory results, is one of the worst dangers to a new plastics industry. This is a complex decision requiring technical knowledge of a wide range of materials and their properties. In forming the product, control of temperature, pressure, timing, and cleanliness must be maintained, or an inferior product will result. Initial determination of these factors requires technical knowledge. Care and vigilance during the production run are necessary to maintain the proper combination.

The American Society for Testing Materials has published a series of tests and standards for plastics products. Standards have also been established by the Society of the Plastics Industry.

Attention to quality is important at the outset in this industry lest a few inferior articles discredit a whole range of products made from plastics.

Competition

Initial domestic competition will come principally from similar articles made of other materials. For many uses the characteristics of the plastic material make it peculiarly desirable to the user of the finished product, but over a wide range of products substitute materials can be used competitively. Pound for pound the plastics materials are generally more expensive than the wood, metal, ceramics, shell, and other materials adaptable to the same products. The great success of the plastics in industrial countries has been due in large measure to the ease with which large numbers of identical units can be produced with less labor than would be required using other materials. Lower labor costs in the less-developed countries may well create an entirely different situation with respect to substitutability of materials, and short production runs required in small markets will also yield different relative costs among alternative processes in the less-developed areas. Careful evaluation of the products to which plastics will be adapted under the conditions existing in a particular country will be required.

The plastics products industry is highly developed and very competitive in the United States. Profit margins on standard mass-produced items are small. The industry is also highly developed in other industrial countries. Imported articles will be available to the less-developed country on terms reflecting these conditions. Other factors favor the local producer: resins can be imported with less transportation cost

than finished products, particularly where hollow forms and other bulky articles are concerned; deliveries are quicker from local sources; consultation in design, cost estimates, etc. are easier for the local operator, and modifications and adjustments in the product after the production run has started are easier to accomplish.

Marketing Facilities Required

Articles made of plastics are distributed in much the same manner as similar articles made from other materials. No special facilities are required for the marketing of the finished products.

The marketing activities of the custom molder or other manufacturer doing contract work for others include technical advice in the design of the product and choice of material. The ability to render this specialized service will be important in developing the business.

Manufacturing Processes

Fabrication. This term is used to describe the conversion of plastics sheets, rods, tubes, and special shapes into finished products such as lamps, jewelry, ornamental boxes, handles, frames, etc. The tools and skills are similar to those used in woodworking and metal-working. Operations vary from small handicraft shops to mass production plants with specialized machine tools.

Also in this category is one of the newest and largest branches of the industry, using plastic sheeting and film to make such things as packaging materials, shower curtains, rainwear, inflatable cushions, toys, etc. The operations involved are similar to those in making similar items from textiles, except that heat sealing may take the place of sewing.

Vacuum Forming. A process in which a sheet of plastics material is clamped in a frame, heated, and then formed into desired contours by vacuum-drawing it into a mold. It is finding wide application in production of compartmented trays and boxes, dishes, trays, cups, toys, advertising displays, and many other items. Edges are trimmed and finished after forming.

Injection Molding. A process in which material is softened by heat and then forced under pressure through a small channel into the cavity of a mold. This is the most widely used process for common plastics items. A very well-designed, manufactured, and finished mold is required. Molds are made of steel, usually by machinery or

hobbing; the molds requiring the highest skills of toolmaking. Molds to receive from one to two ounces of material at a time cost about $750 and up in the United States. For sizable products molds costing $5,000 are common. Large complicated molds can run $25,000 and more. Unless production runs are large, the mold cost becomes a major part of the total cost of the product.

Compression Molding. This method consists of squeezing material into shape by applying heat and pressure to the material in a mold. The mold consists of matching dies. After the material is placed in the mold cavity the mold is closed, heated, and pressed together. Problems of mold making are similar to those mentioned with reference to injection molding above.

Extrusion. Dry plastics material is fed into a screw press, in which it is softened by heat and pressure and then forced continuously through a die to form rods, tubes, hose, pipe, ornamental molding strip, monofilaments for insect screening and upholstery fabrics, etc. Insulation may be applied to wire by this process. Film and sheeting can be extruded, but their production is more complicated than the extrusion of the shapes mentioned above.

Casting. Certain plastics can be melted and poured into open molds at relatively low temperatures and then cured by baking in an oven. In this process the mold is much less expensive than that required for injection or compression molding. A common practice is to make a steel arbor in the shape of the casting, dip it in lead, strip off the adhering shell of lead, and use this shell as the mold. The equipment required for this process is simple, and no large investment is involved.

Cast plastics can be made to yield better colors and translucency than is obtained by the other molding methods. They can be machined about like brass. Since the casting is rough, it requires finishing operations. This process is often used for high-quality cabinets, cases, jewelry, handles, brush backs, lighting fixtures, etc.

Dip Molding. A process commonly used with liquid vinyl plastics. Products such as women's rain boots are made by dipping a warm mold in the plastic, allowing the excess to run off, and then placing the mold in an oven to fuse the plastic. A big advantage of this process is low equipment cost.

Slush Molding. Also commonly used with liquid vinyl plastics. A heated hollow mold is filled with the liquid; the excess is poured out; and the mold is placed in an oven. Dolls, toys, etc. are made in this way. This process also has the advantage of low equipment cost.

High-Pressure Lamination. Formation of sheets, rods, and tubes from paper, cloth, and wood impregnated with liquid resins. This process is used for table and counter top material such as Formica. It requires very heavy presses involving a large investment. Only about 50 companies in the United States produce these materials, but a large number of fabricators fashion the standard sheets and shapes into a variety of finished products.

Reinforcing. This process differs from high-pressure lamination in that very low or no pressure is used. Resin-impregnated paper cloth, or glass fiber is laid up on a mold and cured under light pressure and low heat. Steel molds are not required, which greatly simplifies the tooling and reduces costs; but matched metal dies are sometimes used. The process is particularly adapted to making large, complex shapes, such as boat hulls, vehicle bodies, and furniture, for which dies to fabricate metal are very expensive. The material has very high strength and low weight and is resistant to corrosion. It is suitable for making a variety of tanks.

This is the newest of the processes for forming plastic products, and the accumulated technological knowledge and experience are less in this field than for other processes. A new firm would hence assimilate existing knowledge and be abreast of the industry faster in this field than in others. In making large shapes by this method the material cost would run about $1.00 per square foot. Where short production runs are involved, the fabricating costs are much less than those for steel. In a country where steel is expensive and steel-fabricating facilities lacking, and where markets are small, reinforced plastics may have an even wider application than in the United States. This process appears to have considerable promise for areas in which industrialization is beginning.

Film and Sheeting Processes. Calendering is a method in which plasticized material is passed through a series of heated rollers which squeeze it into a thin sheet. This is a relatively large-scale operation with heavy equipment. Capacities over 1,000 pounds per hour are not unusual in the United States. When long production runs are possible such output rates yield a low cost for finished film in spite of the considerable investment in equipment.

The term casting is applied to a film process in which a thin layer of liquified plastic is distributed on the surface of a wheel or belt, where it dries and is then peeled off. This should not be confused with casting in a mold as described earlier.

Size of Plant

With the exception of high-pressure lamination and the film and sheeting processes, the plastics products industry is adaptable to a wide range of plant sizes. Individual molding machines range from small hand-operated presses to large automatic units of high capacity. A plant can be composed of one or more of these basic machines, plus the auxiliary equipment necessary to its operation. When production runs are large, the advantages of large automatic machinery are apparent, although in a country with low labor costs these advantages will be less than in the United States. Since a large plant is made up of multiple units of the basic machine, and since the cost of the auxiliary equipment which must be combined with these machines is relatively small, the optimum combination of equipment can be reached in small plants. Over half the molding companies in the United States in 1951 had a net worth less than $100,000.

That small producers can compete effectively in this industry is shown by experience in the United States, where the best growth rates have been shown by injection molders with net worth less than $100,000. Molders with sales volume less than $100,000 showed a higher profit per dollar of sales than any other size of group in the molding industry in 1951. The table on the following page compares the small molders with their large competitors in that year.

Raw Materials and Supplies

The materials required by the plastics-molding and plastics-forming industry are principally the plastic resins, which are produced by large chemical companies as part of a wide range of products. There are two general types of plastics. Thermosetting materials set or harden into permanent shapes when heat and pressure are applied. Reheating will not soften them. Thermoplastic materials, on the other hand, become soft when heated and harden when cooled, no matter how often the process is repeated. There are over 25 types of resin in general use, each having its own special properties. Prices in the United States for the commonly used materials range from 15 cents to $1.00 per pound. It is essential for economic reasons as well as performance characteristics to choose the most appropriate material for each job.

THE PLASTIC MOLDING INDUSTRY, 1951
(Expense Items as Percent of Sales)

	Firms with Volume Under $100,000	Firms with Volume Over $1,000,000
Material	34.8	38.9
Labor	17.1	15.6
Burden	17.1	20.0
Cost of Goods Sold	69.0	74.5
Gross Profit	31.0	25.5
Selling Expenses, Total	4.3	9.3
Salaries and Commissions	1/	5.4
Advertising	1.3	1.7
Travel and Entertainment	1.3	1.1
Other	1/	1.1
General and Administrative Expense, Total	6.9	7.7
Executive Salaries	1/	2.7
Bad Debts	1/	.3
Other	1/	4.7
Net Profit Before Taxes	19.8	8.5

1/ Indicates incomplete or unrepresentative data.

Source: It's Your Money, Dow Chemical Company, 1952, p. 30.

Laminating processes require, in addition to the plastics, the cloth, paper, glass fiber, or other reinforcing material used. Some molded products are made with a filler such as sawdust, woodflour, or other fiber, added to the resin.

Machinery and Equipment

Injection Molding. The size of injection molding machines is measured by the weight of the material which they can force into the mold in one "shot." The common size for a small machine is two ounces, with which the maximum mold size is 8 x 10 inches. A semiautomatic machine of this size costs about $3,000 in the United States. It performs one complete cycle of injecting the plastic, cooling, and ejecting the finished part from the mold each time the machine is started by the operator. A 4-ounce machine costs about $12,000, and for the larger sizes the cost increases rapidly. The 2-ounce size would be adequate to start a small shop making a variety of small items such as buttons, combs, etc.

Compression Molding. In this process pressures from 2,000 to 5,000 pounds per square inch are required, making hydraulic presses necessary for pieces of any appreciable size. A small table radio case can be made in a 200-ton press costing about $13,000 with a self-contained hydraulic unit in the United States.

Extrusion. A small extrusion machine complete with grinder, drying oven, and other auxiliary equipment costs from $15,000 to $20,000 in the United States. The cost of dies for this process is moderate, usually running from $50 to $150 each, except for the extrusion of sheet, in which the cost is much higher.

Vacuum Forming. A complete commercial vacuum-forming machine costs from $5,000 to $9,000 in the United States. Low cost molds of wood, plaster, or plastics can be used for runs of several thousand pieces.

Calendering. The machine, together with the necessary take-up devices and auxiliary equipment costs upward of $250,000.

Fabrication, Casting, and Reinforcing. These operations require little specialized equipment. Woodworking and metal-working equipment is used in making forms and molds and in finishing operations.

Auxiliary Equipment. The molding processes require grinders and weighing equipment for the preparation of materials, and these are not included in the cost estimates given above. Sources of steam and compressed air are usually required in a plastics products plant. Sanders, polishers, and other small tools are needed in finishing operations.

Energy Requirements

Electricity is required if power-operated machinery is to be used, and fuel for a steam boiler is necessary as a source of heat for molds and material. A very small plant might use electric heat. Total energy requirements are small in relation to value of output and in comparison to most manufacturing processes.

Buildings and Utilities

Molding materials need a clean, dry warehouse, and the processing area must be kept clean. There are no other special considerations with respect to buildings. Demands for water and electricity are not great. There are no special problems of waste disposal.

Personnel

Labor. Total labor requirements in most processes are small in relation to value of output. By selection of hand-operated and hand-controlled machinery as opposed to automatic machines the labor ratio can be varied considerably in the molding processes.

Operators of molding machines are classed as semiskilled. In the United States it has proved possible to train operators on the job in three months to one year. In laminating and calendering operations considerable skill is involved, and a longer training period is necessary. Finishers, who take parts as they come from molding machines and polish, file, sand, etc. require little skill. Fabricators of rigid plastics use the same skills as woodworking or light metalworking. Fabricators of film and sheeting require essentially the same labor as textile fabricators. Mold makers must be very highly skilled, especially if steel molds are used.

Technical. Design engineers with intimate knowledge of properties of various materials and the machinery available are needed, as are salesmen to work with industrial customers. Setup of machinery and timing the production cycle require technical knowledge and experience.

Management. Knowledge of plastics materials and ability to evaluate potential uses are essential. Foremen require ability to inspect and control quality of product. In a small shop the manager may supply the technical ability needed in product design and selling and in determining production techniques.

Supporting Services

Ability to draw on outside machine shops for repair work will reduce the need for shop equipment and machinists in the plant. It is a common practice in the United States to secure molds from independent specialists in mold making, but in Australia most molders have their own toolrooms and make their own dies.

There is a large body of literature on the practical problems encountered in plastics-forming operations. An operator with basic technical and mechanical knowledge can solve many of his problems by reference to this literature. The resin suppliers have highly developed technical advisory services which are available to users of their products in the United States. Availability of such services in other areas will vary.

Key Location Factors

The plastics-products industry tends to locate near the market for its products, which in industrial countries means close to the centers of other manufacturing. Such location is influenced largely by the necessity for working closely with industrial customers in the design and production of plastic parts. It is also cheaper to ship the unformed raw materials than to ship finished products, and the necessary labor skills are more readily available in industrial centers.

Role in Integrated Development

The industry has no particular developmental leverage; it may be expected to follow other industries rather than to precede them; and may be important in the assembly industries which depend largely on imported parts, in that the plastics industry provides means for local manufacture of certain parts. In countries where the cost of metals is high, reinforced plastics may have wider applications than in the industrial countries, e.g. as a substitute for steel in tanks, thus facilitating other developments.

Stability

The industry has no independent seasonal or cyclical patterns. It will tend to follow the general course of industrial activity and consumer incomes.

Balance of Payments Effects

Unless the chemical industry is already well developed and can undertake the production of resins, the import of plastics materials would be required. Machinery, and possibly molds, would probably be imported for those processes requiring specialized machinery. If plastics replace local materials or stimulate demand for new types of consumer goods there would be a tendency for adverse balance of payments effects until the country could produce its own machinery and resins. If imported products of plastics or other materials are replaced by locally made plastics items there would be a tendency for favorable effects.

Social Aspects

The plastics-products industry is clean, offers no special hazards, and would generally be considered socially desirable.

Experience in Newly Developing Areas

A good description of the plastics industry in Australia is available. (See Sources of Additional Information following.) There is a well-developed plastics industry in that country, but the high cost of molds and the small market make it cheaper for Australia to import such items as toys, jewelry, etc., in which a wide variety of choice is important.

Four small companies are reported to be making combs, hangers, belts, and some household articles in Venezuela. A wider variety of plastic articles is made in Colombia, including electrical fixtures, combs, buttons, cups, plates, toys, and brushes.

Injection molding plants are known to have been started recently in India and the Philippines to make small items such as combs, buttons, etc. In Manila, injection molding wall tile has been a major product.

SOURCES OF ADDITIONAL INFORMATION

Books, Pamphlets, Periodicals

Brief Review of the Australian Plastics Industry, Commonwealth of Australia, Ministry of National Development, Division of Industrial Development, Melbourne, 1950.

Delmonte, John, Plastics Molding, Wiley, New York, 1952.

Fiberglass Reinforced Plastics, Ralph H. Sonneborn, ed., Reinhold Publishing Corporation, New York, 1954. A manual by plastics engineers covering materials, techniques, design, and applications.

Modern Plastics, monthly, 575 Madison Avenue, New York 22, New York. (Pan-American countries $[illegible].00, other countries $12.00 per year, single copies $1.25.) Covers materials, uses, techniques, equipment. Maintains literature service for distribution organizations in the industry.

Modern Plastics Encyclopedia and Engineer's Handbook, Plastics Catalogue Corporation, New York, 1953. Reference book covering various aspects of the industry.

Plastics Progress, Phillip Morgan, ed., Iliffe, London, 1953.

Plastics, The Story of an Industry, The Society of the Plastics Industry, 5th ed., New York, 1953. A brief description of the materials, processes, and organization of the industry from which much of the material in this profile was taken.

Robinson, Clark N., Meet the Plastics, MacMillan, New York, 1949. Description of products, molding processes, skills required.

Simonds, Herbert R., Archie J. Weith and M. H. Bigelow, Handbook of Plastics, D. VanNostrand Company, Incorporated, New York, 1949. A reference book on materials, processes, and other aspects of the industry.

Simonds, Herbert R., Archie J. Weith and William Schack, Extrusion of Plastics, Rubber, and Metals, Reinhold Publishing Corporation, New York, 1952.

Trade Associations

The Society of the Plastics Industry, Incorporated, 67 West 44th Street, New York 36, New York.

IV. CEMENT INDUSTRY

Products

Portland cement is familiar as the basic ingredient in concrete. Standard specifications for cement cover five types of this product. By far the major part of the industry output is general-purpose construction type of cement. The other types have been developed for special characteristics, such as high early strength, low heat of hydration, and resistance to sulphate action from surrounding water or soil. Air-entraining agents may be added to each of the basic types. Air-entraining cement yields a concrete containing a vast number of tiny air cells which give the concrete desirable properties for certain applications, particularly resistance to the action of freezing and thawing.

Organization and Structure of the Industry

Savings in production costs in large plants tend to make the individual plant in the cement industry a large-scale operation. (See Size of Plant following.) The desirability of locating a plant near its market, on the other hand, leads to a multiplicity of plants in a large country rather than great expansion at a few locations. In the United States there are several very large companies manufacturing cement, but these companies each operate several plants. (See Key Location Factors following.) A cement plant is an integrated unit which extracts its own principal raw materials from local sources and turns them into the finished product.

The Market

The demand for cement is a derived demand arising from the use of concrete in building and construction. Estimating the market for cement therefore becomes a problem in estimating the course of construction in an area. Known plans for major projects, such as highways, dams, aqueducts, docks, airports, etc. may indicate rather clearly the minimum needs of a country for cement for some time to come.

The market for cement may be expected to expand greatly as a country proceeds in its economic development, and in addition to projects of the types mentioned above, housing, commercial and industrial construction, farm buildings, sewers, sidewalks, and other concrete construction will require growing amounts of cement. Per capita use of cement in the United States has approximately doubled in the last 25 years.

Quality Standards

In the United States cement is produced according to specifications of the American Society for Testing Materials, the American Association of State Highway Officials, and agencies of the state and federal governments. The specifications of these groups are practically identical, with the result that cement in the United States is a standardized, uniform commodity regardless of brand or place of production. This greatly facilitates the use and marketing of the product.

The tendency in specifications is to rely as much as possible on performance tests, allowing the manufacturer to achieve the desired properties by the methods best suited to his operations.

The ability to produce cement which is uniform and up to specification is vital to the success of this industry. The cost of cement is a small part of the total cost of a construction job, but failure of the cement would ruin the entire structure. Unless they can rely upon the performance of the cement, engineers and contractors cannot contemplate its use. Appropriate specifications should be established and followed from the outset in this industry.

Competition

Cement is produced in great volume in all industrial countries and is produced to some extent in over sixty countries of the world; it is very heavy in proportion to its value, making it relatively expensive to transport. This factor greatly limits competition among producers in different countries and in different areas within a country. As new market areas develop there will hence be opportunities to establish new cement plants near those markets, such plants having a substantial degree of protection from outside competition because of high transport costs.

The ability of new plants to capture a market area depends, of course, on the production of cement which meets the necessary specifications. A builder cannot afford to accept an inferior product even though it is cheaper.

The high proportion of fixed costs in this industry tends to intensify competition during periods of low cement consumption, because the plants can recover the variable costs of production with selling prices substantially below those usually prevailing in the industry.

Marketing Facilities Required

Quality standards are one of the most important aspects of marketing cement. The ability to deliver a uniform product meeting specifications which can be accurately described promotes the use of concrete in the design of construction projects, because the engineer can then rely on the characteristics of the material he prescribes. From the standpoint of the individual producer this ability makes it possible for him to offer his cement in competition with that from other sources.

Another important facility in the marketing of cement is transportation. The cost of shipping the finished product limits the market area which can be served by a plant in effective competition with other plants. Facilities for handling cement in bulk reduce transport costs and tend to extend the market area.

Storage facilities which protect the cement from moisture must be provided wherever a supply must be kept on hand. In humid climates special silos may be necessary if cement is to be held for any substantial period.

Manufacturing Processes

A cement plant includes both the actual manufacturing operations and the extraction from the earth of the principal raw materials. These materials are so bulky and low in value per ton that they are ordinarily extracted at the plant site as part of an integrated operation. The principal raw materials are some form of lime-bearing material and an argillaceous or claylike material. These are extracted by quarrying or dredging, depending on the types of material used and the local conditions of occurrence. This phase of cement production will not be described in detail here. (See Raw Materials and Supplies following.)

In essence the manufacture of cement consists of three steps: (1) grinding and blending the raw materials in proper proportion, (2) burning the blended materials to a clinker in a kiln, and (3) intergrinding the clinker with gypsum to an extremely fine powder, which is Portland cement. In practice these processes are very exacting in nature and require some 80 separate operations. There are two general methods of manufacture—the wet process and the dry process—the difference being in the preparation of the raw materials. The method used will depend on local conditions. Grinding the materials is somewhat easier in the wet process, but fuel consumption in the kilns in this process is substantially higher.

The manufacturing processes are shown schematically in the flow chart Figure 3 on the following page. Both wet and dry processes are illustrated, although an actual plant would employ only one of them.

Grinding and blending the raw materials are critical steps, and the ground materials are chemically tested at frequent intervals day and night so that proportions can be changed as necessary to maintain a uniform product. Accurate control of the burning process is also essential, and constant attention by a skilled kiln operator is required. Kilns are ordinarily fired with pulverized coal, oil, or natural gas, although other fuels have been used.

The clinker from the kiln is cooled, after which it may be stored easily. Storage of clinker is a method used to take care of differences between kiln output and the current demand for finished cement. To make the finished product, the clinker is mixed with a small percentage of gypsum and ground to a very fine powder. The gypsum regulates the setting time of the cement. The finished cement is continually tested to insure that it meets the necessary specifications.

In the United States the unit in which cement is sold is the barrel, which is 376 pounds net weight, although none is actually packed in barrels. The packing unit is a bag of 94 pounds net weight, which is one cubic foot of cement. Multiwall paper containers have largely replaced cloth sacks. In the United States there has been rapid growth in bulk shipments of cement in special trucks and railroad cars.

Size of Plant

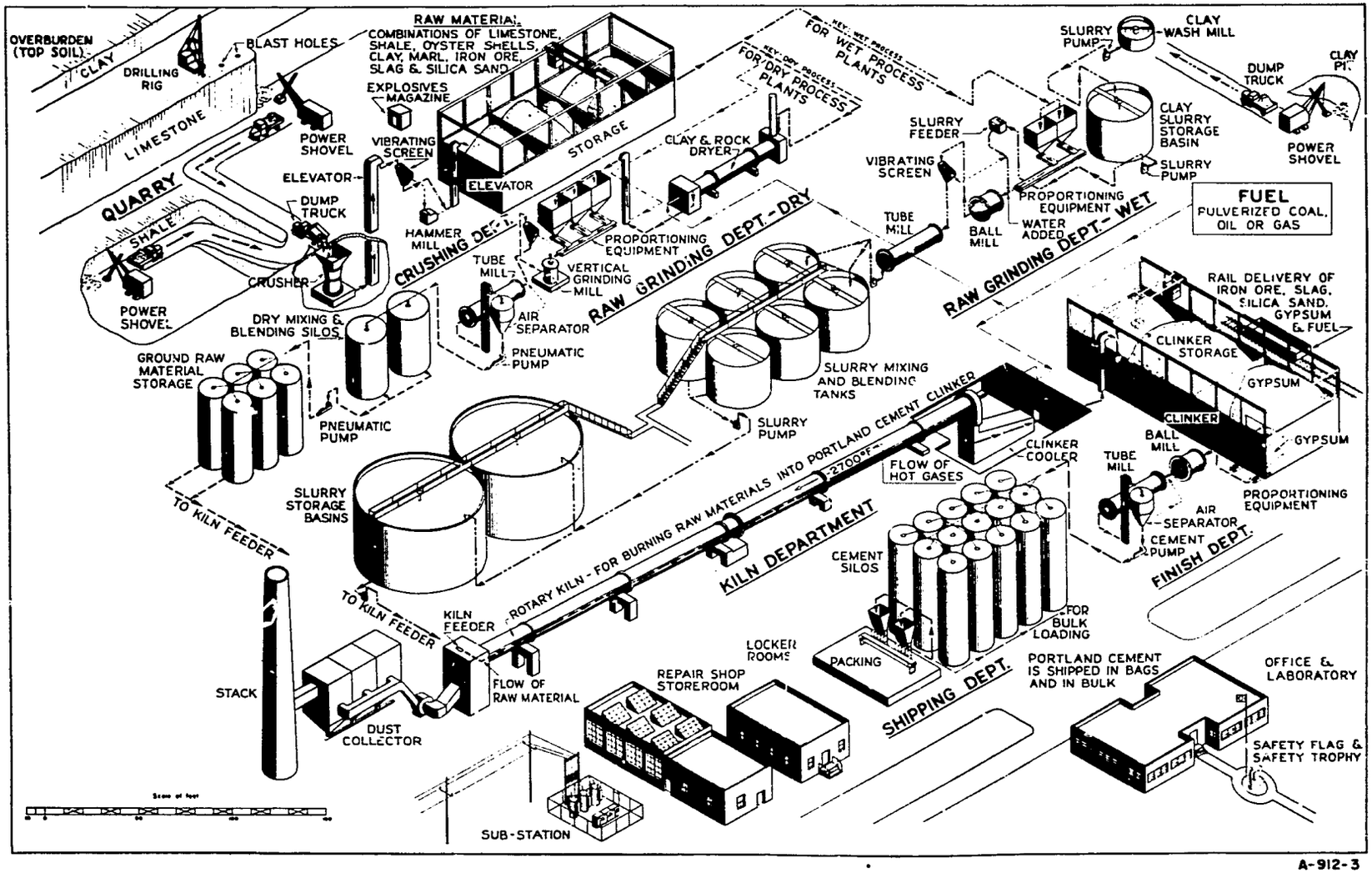
For several reasons, cement can be produced more efficiently in a large plant than in a small one. The large sizes of kilns, grinders, and other equipment have greater mechanical efficiency than small sizes; the number of machines, rather than their size, is the principal determinant of the number of operations required; the investment cost per unit of output is lower for large machines than for small ones, and large kilns have better fuel utilization than small ones. The cost of testing facilities, management, and other overhead items is less per unit of output in a large plant.

In the United States a plant with about one million barrels annual capacity is considered the minimum economical size. Such a plant can be composed of single units of the major pieces of equipment—raw material grinder, kiln, finish grinder, etc.—and these units are of a size having good mechanical efficiency and favorable investment cost per unit of output. A two-million-barrel plant would probably be

FIGURE 3

MANUFACTURE OF PORTLAND CEMENT

Isometric Flow Chart



A-912-3

designed on the basis of two units of such pieces of equipment and would offer some advantages in cost of site development, repair, and laboratory facilities, management, etc., making it near the optimum size. Diseconomies are likely to be encountered in the four- to five-million-barrel-size range.

Size characteristics for plants outside the United States would not be greatly different. The operating characteristics of the machines remain the same. The process is not adaptable to hand labor, and even though a small machine will require more operator time per unit of output, the total labor requirements run only a fraction of a man-hour per barrel. The smallness of the labor requirement tends to minimize the effects of wage differences. In the mining or quarrying phase of the operation the possibilities for more labor-intensive methods are greater but would not be a determining factor.

In spite of the lesser efficiency and higher investment cost per unit of output of a small plant, an area with a market for less than a million barrels of cement may well find it advantageous to build a plant of small size suited to its market. The high cost of transporting finished cement may enable such a plant to deliver in its market area at lower prices than can be offered by a large plant located at a distance from that market. The small plant has the advantage of a smaller aggregate investment cost, even though the cost per unit of capacity may be higher.

Raw Materials and Supplies

The principal components of cement are lime, silica, alumina, and iron oxide. These can be found in a variety of materials occurring in nature, and the problem of the cement manufacturer is to secure the right combination from those materials which are plentifully available to him. The most common materials used are limestone, shells, chalk, or marl which are combined with shale, clay, slate, or blast furnace slag. On the average in the United States about 650 pounds of these raw materials are required to produce one 376-pound barrel of cement. The weight loss is due to calcination in the kilns, during which moisture, carbon dioxide, and other gases are driven off.

Gypsum, generally from 3.5 to 5 percent by weight, is added to the clinker before the final grinding.

The maintenance of the large amount of heavy equipment in a cement plant requires lubricants, machine shop supplies, welding supplies, etc. Fire brick for kiln linings and steel ball changes for the grinding mills are significant items.

Machinery and Equipment

The principal pieces of equipment for a cement plant are shown in the flow chart of the production process, Figure 3. Individual units of equipment can be secured in a wide range of sizes (see Size of Plant). Annual capacity up to about one and a half million barrels can be provided on the basis of large single units of the principal pieces of equipment. A plant based on single units may be expected to have greater mechanical efficiency and lower labor requirements than a plant of similar capacity composed of multiple units.

The investment required to build new cement plants in the United States in recent years has varied greatly from plant to plant, ranging approximately from $6.50 to $11.00 per barrel of annual capacity. Typical costs are estimated currently to be about $7.00 per barrel for plants with capacities of 2 million barrels and up. This cost would rise to about $8.00 per barrel for a one million barrel plant and would be still higher in smaller plants. Variations due to local conditions and raw materials to be used may be expected.

About 80 to 85 percent of the cost of a plant represents purchase and installation of machinery, the remainder going for construction of buildings, storage silos, shops, etc. In the United States the cost of installing the machinery is a large element of total cost. Local labor at the plant site is a major part of this installation cost, and in other areas lower wage rates could reduce this element of total plant cost.

Energy Requirements

Heat requirements in kilns run about one to one and one-half million B.T.U. per barrel of cement produced with the wet process. In the dry process about three-fourths as much is used. The United States Bureau of Mines has prepared fuel consumption statistics for United States plants in 1951. These data cover plants using each of the three principal fuels but are confined to situations in which the individual plants used only one of the fuels. Average consumption of fuel per barrel of cement (376 pounds) is shown below for the three fuels.

Coal	114.6 pounds
Oil	8.66 gallons
Natural gas	1,437 cubic feet

These figures cover both wet and dry process plants and include all fuel consumed in the plants, part of which was used to generate electric power in some plants, while other plants purchased electricity from outside sources.

It has been reported that in Australia about 30 tons of coal (approximately 10,000 B.T.U. per pound) are used in firing cement kilns for each 100 tons of cement produced. For generation of electric power in the cement plant about 20 additional tons would be required.[1/]

The cement industry is a heavy user of electric power. Modern machinery is all driven by individual electric motors, ranging from small ones on conveyor systems up to 500-1,000 horsepower motors on the grinding mills. From 20 to 30 kilowatt hours of electric power are required per barrel of cement produced. Since the plant operates continuously, this is a steady load twenty-four hours a day, seven days a week.

Buildings and Utilities

Large buildings designed for the purpose are required to house a cement plant, and storage facilities for the ground raw material, clinker, and finished cement require special construction. Heavy foundations are needed for the machinery. In the United States it is estimated that 15 to 20 percent of the total investment in a cement plant represents construction on the plant site exclusive of direct machinery installation costs.

Electricity requirements are described under Energy Requirements.

Personnel

The nature of the production process requires that a cement plant be operated continuously. Provision for manning the plant day and night, seven days a week, must therefore be made.

The degree of mechanization achieved in plants in the United States makes the industry a relatively small employer of labor in proportion to the volume of its output. (See Size of Plant.)

1/ Brief Review of the Australian Portland Cement Industry, p. 17. (See Sources of Additional Information.)

Machine operators are considered semiskilled and are ordinarily trained on the job. The kiln operator must be highly skilled. The considerable volume of maintenance work on heavy equipment requires skilled mechanics and machine-shop men. Lining kilns with firebrick requires a specialized skill. A chemist is required for quality control work, and physical tests of the finished cement must also be continually made.

Supporting Services

Cement industry associations in industrial countries sponsor research in the uses and improvement of concrete and cement. Government, universities, and other organizations study applications of concrete and the requirements of cement for purposes of interest to them. All of these activities promote wider use of the product and are of assistance to the cement industry. They are not essential to the establishment of the industry in a given country, however, and may be expected to grow up as the industry develops.

Key Location Factors

The great bulk of the raw materials and the large weight loss in the manufacturing process make it necessary that a cement plant be located at the source of the materials. Fuel consumption is heavy, and the cost of transporting the finished cement to market is also a major expense item. These factors must be considered in planning the location of a plant. In the United States the widespread occurrence of cement raw materials and fuel has made it possible to give primary consideration to the market, but this may not be true in other countries. The development of the industry in some countries has been blocked by lack of suitable materials and fuel close to the centers of population which comprise the market.

Role in Integrated Development

The importance of concrete construction in the development of transportation, power, water resources, and other projects essential to the economy of an area gives this industry major importance in a development program. It is difficult to conceive of any substantial growth of industry without concrete. Although the investment required for a cement plant is large, it is not nearly as great as that required for a steel mill. Modern methods of using concrete in construction such as prestressing, make it possible to reduce substantially the amounts of steel required. In areas where steel is relatively expensive, it may prove desirable to apply these modern methods to an even greater extent than they are used in the United States.

Stability

In temperate climates outdoor construction is a seasonal industry, and the demand for cement reflects this fact. To some extent, cement plants are able to produce for stock during the periods in which cement consumption is light, thereby stabilizing operations. Since clinker is more readily stored than finished cement, it is a common practice to stockpile clinker for grinding during the periods of high cement consumption. This permits kiln capacity to be less than maximum seasonal output of finished cement. However, this practice leads to storage problems and heavy inventory financing, which limits its application.

The construction industry is subject to wide cyclical fluctuations, which produce corresponding fluctuations in the use of cement. Public works programs undertaken as countercyclical devices in times of reduced business activity would tend to mitigate these effects, making government policy with respect to such programs an important factor for the cement industry.

For a note on price stability see Competition.

Balance of Payments Effects

An initial importation of machinery and equipment would be required in most countries. Current imports of general-purpose cement in the market area of a plant would be replaced by local production, although special purpose cements would probably continue to be imported. Because of the size of the initial investment in machinery the short-run effects on the balance of payments may be expected to be unfavorable. The effects of a good supply of cement on the development of other industries and projects makes the long-run influence on the balance of payments harder to predict. To the extent that more heavy construction is encouraged, further imports of equipment, steel, etc. would be required. However, a period of heavy investment in transportation, power, water development, etc. is ordinarily required as a basis for future industrial development which may lead to foreign exchange earnings sufficient to recover the initial investment.

Social Aspects

The cement industry in the United States has an outstanding safety program and one of the best records in heavy industry for accident prevention. Similar programs should be followed wherever plants are established.

A cement plant can liberate a considerable amount of dust, a factor which should be considered in plant location. However, with modern dust-catching equipment of proper size and design the dust problem can be almost entirely overcome.

Experience in Other Underdeveloped Areas

Cement is being produced in over sixty countries of the world. Actively developing countries such as India and Turkey are greatly expanding their production; and in the last few years plants have begun operation for the first time in several of the smaller countries where industrialization is just beginning. For example a 250,000-barrel plant was opened in El Salvador early in 1954, and plans are underway to double this capacity. The first plant in Haiti began shipments in July 1954. It has an annual capacity of about 300,000 barrels.

SOURCES OF ADDITIONAL INFORMATION

Books, Pamphlets, Periodicals

Alderfer, E. B., and H. E. Michl, Economics of American Industry, 2d ed., McGraw-Hill, New York, 1950, Chapter 13, "The Cement Industry."

Bogue, R. H., Chemistry of Portland Cement, Reinhold Publishing Company, New York, 1947.

Brief Review of the Australian Portland Cement Industry, Commonwealth of Australia, Division of Industrial Development, Ministry of National Development, Melbourne, 1951.

Dowd, Charles, Portland Cement, Concrete Publications, Ltd. London, 1948.

Glover, J. G., and W. B. Cornell, editors, The Development of American Industries, 3d ed., Prentice-Hall, New York, 1951, Chapter 20, "The Cement Industry" by J. F. Neylan.

Persons, Hubert C., The Portland Cement Industry, Bellman Publishing Company, Boston, 1950.

Witt, J. C., The Technology of Portland Cement, Chemical Publishing Company, Brooklyn, New York, 1951.

Rock Products, monthly, 309 West Jackson Boulevard, Chicago 6, Illinois. $2.00. The annual directory and outlook issue lists manufacturers of equipment and supplies for the industry.

Pit and Quarry, monthly, 539 South Clark Street, Chicago 8, Illinois. $3.00.

Concrete, monthly, 400 West Madison Street, Chicago 6, Illinois. $3.00.

V. BOTTLED SOFT DRINK INDUSTRY

Products

Carbonated beverages, commonly known as soft drinks or soda, consist of water which is saturated with carbon dioxide gas, to which has been added sugar syrup, flavoring, and often a small amount of suitable acid. The mixture is bottled under pressure to retain the carbon dioxide, or carbonation. These beverages are produced in a wide variety of flavors, which may be made from natural fruit juices, roots, barks, herbs, berries, and special flavoring mixtures. The brand names of certain proprietary flavors are internationally known.

Carbonated beverages are sold in re-usable bottles usually ranging from 6 ounces to 32 ounces in capacity. Sizes from 6 to 12 ounces are the most common. Canned soft drinks have recently been introduced in the United States, and it is not yet clear to what extent the metal container will replace the bottle. Canning equipment is considerably more complex and expensive than bottling equipment, and this method of packaging is not discussed in this profile. If the metal container should capture a large share of the market, the implications for the industry would be many, and bottlers are carefully studying the new process and its effects.

Organization and Structure of the Industry

There are about 6,000 bottling plants in the United States, of which more than 98 percent have less than 100 employees. Almost one-third of the plants have less than 5 employees. The plants are widely scattered and are nearly all individually owned by local businessmen. This production pattern is brought about by two things: first, the relatively high costs of distributing the finished product and recovering the empty bottles, which restricts the area that can be economically served by a plant; second, by the ability of the industry to produce efficiently in small plants.

Bottled carbonated beverages are distributed through a variety of retail outlets, grocery stores, refreshment stands, and vending machines, which are supplied directly by the bottling plant. In this phase of the industry it is the brand structure which is of particular interest. Some independent local bottlers produce a variety of standard flavors which are sold under their own brand names in a limited market area.

On the other hand, there are certain brands which are advertised and sold in large regional, national, or international markets. The latter brands account for a very large share of the sales of the industry.

Some of the leading brands represent a full line of different flavors, while others represent a single beverage, the composition of which is a closely guarded trade secret. It is common practice for the owners of widely distributed brands to license local bottlers to make and sell the branded beverage. The brand owner supplies the distinctively flavored syrup, supervises the bottling process and conditions to insure uniformity and high quality, carries on intensive advertising, and assists the bottler in sales promotion. The bottler owns his plant and manages his own business, subject to the conditions of his franchise agreement with the brand owner. United States brands of carbonated beverages are being bottled and sold in many countries under such franchise arrangements.

The Market

Carbonated beverages enjoy a vast market in the United States, where sales exceed one billion dollars annually. They have similarly found ready acceptance in many other countries. Markets of phenomenal size have developed in countries where incomes are generally quite low. Individual bottles can be purchased for a few cents, which puts the product within reach of consumers with even a very small cash income. In most countries there will have been sufficient experience with the product to provide an indication of its acceptability and market potential. The market can easily be tested with imported samples.

Quality Standards

In the United States soft drinks are considered a food product and are subject to all state and federal regulations applicable to foods. Such regulations cover matters of sanitation, purity of ingredients, etc., and are designed to insure that food products will be pure and wholesome. Appropriate standards of this nature will be desirable in any country.

Where the industry is highly developed, competition among bottlers leads to efforts to produce the best possible product and not merely to meet minimum standards. This requires proper equipment, good materials, and care in processing. When beverages are bottled under franchise arrangements (see Organization and Structure of the Industry) the brand owners require strict quality control supported by frequent

tests during bottling operations. The same supervision is exercised over franchised bottlers outside the United States to insure world-wide high quality and uniformity in the products.

Competition

The high cost of transportation in proportion to the value of carbonated beverages tends to protect a bottler from competition from distant plants. Competition among bottlers in the same market area, however, tends to be intense.

The bottler depends for his success on consumer preference for his product, which leads to emphasis on consumer advertising in the industry. In this connection the media which cover large areas—magazines, radio, television—are often very effective. Only brands having wide distribution corresponding to the coverage of the media can afford to use them, which affords some advertising advantages to the widely distributed brands. Similarly, the brands that are widely distributed are supported by specialized sales staffs which assist local franchised bottlers in establishing their distribution systems and in sales promotion.

Marketing Facilities Required

Frequent delivery of full bottles and pickup of empty bottles at the retail outlets served by a bottling plant are desirable to keep stocks of beverage at a minimum working level and to reduce the number of bottles which the plant has in circulation. The investment in bottles is significant, and fast turnover keeps this investment at a minimum. Most beverages are sold direct to retailers and delivered in the bottlers' trucks by driver-salesmen. These driver-salesmen arrange displays in stores, insure that coolers are properly maintained, kept clean, etc.

Maintenance of high quality and uniformity in the product are important aspects of marketing. The amount of advertising required will vary with local conditions. Franchised bottlers receive help from the brand owners in all aspects of their marketing programs.

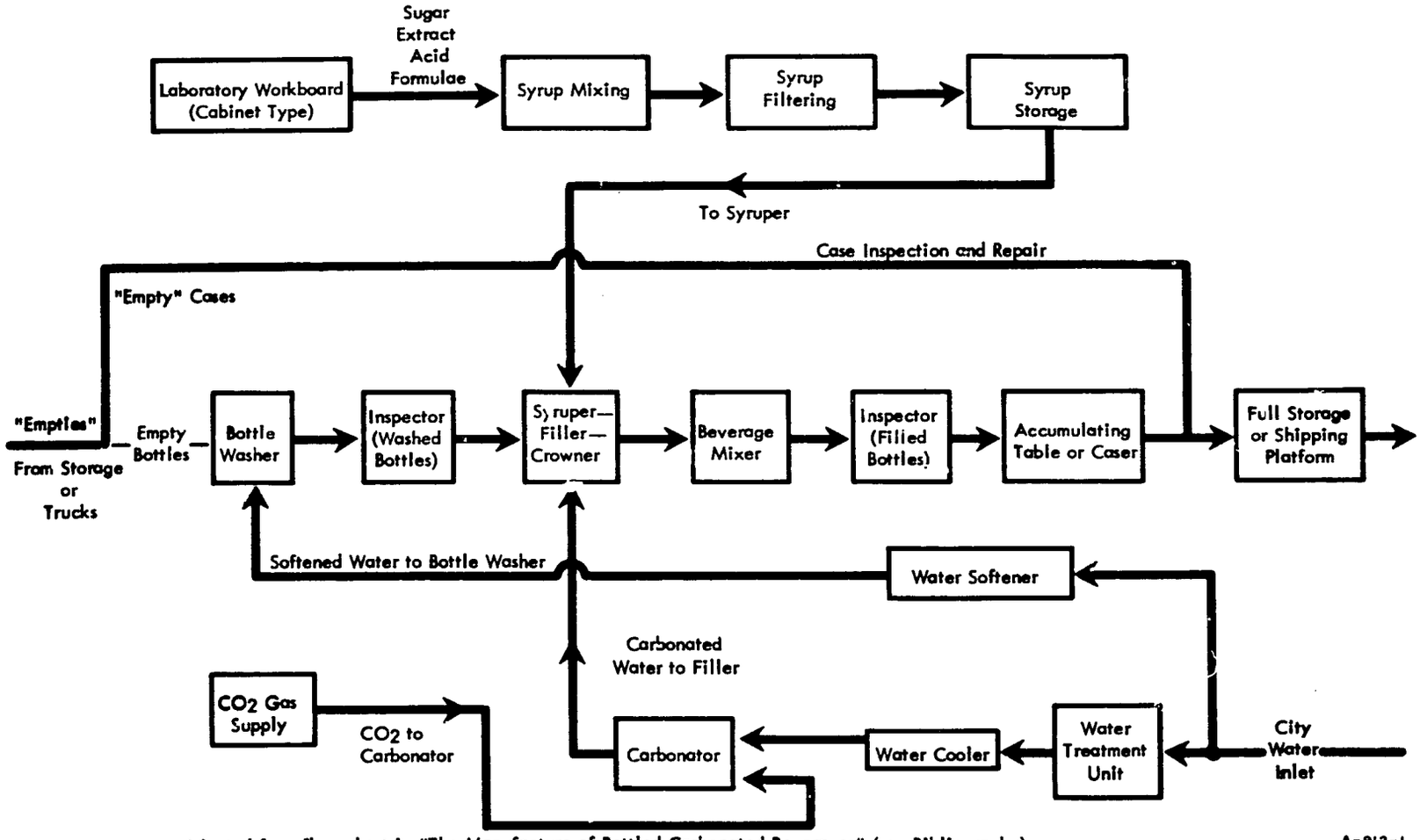
Manufacturing Processes

Figure 4 is a flow chart which illustrates schematically the processes involved in making bottled soft drinks.

The manufacture of a carbonated beverage consists essentially of placing a quantity of a flavored syrup in a sanitized bottle, filling

FIGURE 4

CARBONATED BEVERAGE BOTTLING PLANT
FLOW CHART



Adapted from flow chart in "The Manufacture of Bottled Carbonated Beverages" (see Bibliography).

A-912-1

the bottle with carbonated pure water, crowning the bottle with a gas-tight seal, and agitating the bottle to mix the contents. The bottle may then be labeled if desired and placed in a wooden case or paper carton for delivery to customers. All phases of this process must be carefully controlled, and some specialized machinery is required.

To make the syrup, high-quality sugar is dissolved in purified water, usually in the amount of 5 or 6 pounds per gallon. Flavoring materials are then added, as is a small amount of edible acid, such as citric, phosphoric, or tartaric. Additional color may also be added. For some beverages, such as root beer, no acid is employed. Bottlers ordinarily buy flavoring materials already compounded for each distinctive flavor to be bottled. In the case of the widely distributed proprietary brands the complete syrup is prepared by the brand owner and reaches the bottlers ready to use.

All water used in the plant must be sanitary and suitable for drinking. Regular drinking water, however, seldom meets the very high-quality standards required for the syrup and carbonated water going into the beverage itself. Water treatment is nearly always required to improve clarity, taste, color, and mineral content.

Carbonated water is made by dissolving in the purified water a quantity of carbon dioxide gas. This is accomplished in a special device known as a saturator, or carbonator, which exposes a large water surface to the action of the gas under pressure. The amount of dissolved carbon dioxide can be varied by changing the temperature and/or pressure under which the carbonation is carried on. Different beverages require different degrees of carbonation. The water is usually cooled, as the carbon dioxide gas is more readily absorbed by the water and the carbonated water maintains greater stability between the carbonation point and the capping of the bottle.

Empty bottles must be thoroughly cleaned and sanitized before filling. This is accomplished by washing in caustic solutions at high temperatures. In order to meet sanitary requirements in the United States mechanical bottle washers are necessary. Washed bottles are inspected before filling to eliminate any which are cracked or defective.

A syruper-filler-crowner machine injects the proper amount of syrup into the clean bottle, fills it with carbonated water to the proper level, and presses a metal crown on the top. The contents are then blended by agitating the bottle, either by hand or by machine. Bottles are inspected and placed in cases, again either by hand or machine.

There is a method of filling bottles in which the syrup and water are mixed before carbonation and then injected into the bottle in one step, but this process is not as commonly used as that described above.

Careful sanitation is required throughout the manufacturing process. Machinery is designed for easy washing and sterilizing, and cleanliness throughout the plant must be emphasized.

Size of Plant

Efficient production of high-quality beverages is possible in plants having a wide range of sizes. In the United States there are many "one truck" plants, one delivery truck being sufficient to handle up to about 30,000 cases (24 small bottles each) per year. Such a business can be run by two or three men. The bottling line would be in operation only part of the regular working hours, with the men devoting part of their time to delivery, preparation of materials, maintenance, etc. By more intensive use of the equipment a small plant can expand its output over a substantial range.

Equipment currently used in the United States for filling and sealing bottles is automatic or semiautomatic in operation. (See Machinery and Equipment.) The smallest units are capable of speeds up to 30 small bottles per minute under favorable conditions, while larger sizes can handle outputs as high as 360 bottles per minute. Multiple units can be combined in a plant, creating a great deal of flexibility in plant size. Investment requirements per unit of capacity are less with large-scale equipment but the importance of other costs in the total operation allows the small plants to be highly competitive.

Hand-fed, hand-operated filling machines handling only a few bottles per minute were once used in the United States, but are no longer economically feasible. (See Machinery and Equipment.) They would perhaps still be useful in areas with low wage rates.

Raw Materials and Supplies

A finished beverage usually contains from 6 percent to 16 percent of sugar by weight. 1/ A high-quality sugar is needed.

1/ The Manufacture of Bottled Carbonated Beverages, edited and revised by Henry E. Medbery, American Bottlers of Carbonated Beverages, Washington, 1945, p. 5.

Prepared flavoring material for the standard flavors is available from supply houses serving the industry. A new bottler would probably rely on such preparations. In the case of proprietary beverages the concentrated flavor or complete syrup is supplied by the brand owners.

The best quality carbon dioxide is required. A 50-pound drum of gas should make 600 to 700 cases of 6-ounce bottles of most beverages.

A plant may be expected to use from three to five gallons of water per case of beverage bottled. All water should be potable, and that going into the beverages is usually treated to produce a high degree of purity. Water treatment chemicals and washing compounds are essential supplies.

Major supply items are the bottles and cases required for the finished product. A good-quality bottle is required to withstand the internal pressures encountered. The number needed by a plant depends on the maximum output rate and the frequency with which empty bottles can be returned to the plant. Small bottles cost about five cents each in the United States, and on the average the bottlers lose one bottle out of each case delivered to customers.[1/] Bottle loss experience may be expected to vary with local conditions.

Bottles are sealed with a metal crown which has a cork lining. These crowns are available from manufacturers in the United States and elsewhere.

Machinery and Equipment

The components of a bottling line are shown in the flow chart, Figure 4. This equipment is available in a variety of sizes and is ordinarily connected with conveyors which move the bottles from one machine to another so that handling is not required from the time they are placed in the washer until the filled bottles are in cases for delivery or have reached the accumulating table for hand-casing. Four typical lines are described briefly on the following page.

1/ American Bottlers of Carbonated Beverages, Members' Information Bulletin, "Average Bottle and Case Loss With the Trade," June, 1953.

The smallest commercial equipment regularly available in the United States would be organized around a syruper-filler-crowner machine having a capacity up to 30 six-ounce bottles per minute, depending on local conditions. Such a machine can be fed by hand, in which case the skill of the operator becomes an important factor. Depending on the number of hours daily such a line is operated, a wide range of annual outputs is possible. An expanding business can be handled by increased utilization of the equipment. The total cost at United States factories of the washer, filler, carbonator, water treating and cooling equipment, syrup room equipment, mixing machine, conveyors, and accumulating table would be about $30,000. The bottle washer is the most expensive item, running about $11,000. If the filler were hand-fed and the filled bottles agitated by hand, the outlay would be reduced about $3,000. In bottling a proprietary beverage using ready-made syrup a further reduction of about $1,000 could be achieved through simplifying the syrup room. Bottles, cases, trucks, and a small steam boiler are not included in the above estimates.

A fully automatic line, except for a casing machine, capable of handling up to 120 six-ounce bottles per minute would currently cost about $56,000 in the United States, while a line handling up to 170 bottles per minute would run about $79,000. Equipment for a 300-bottles-per-minute line, including automatic caser, could be obtained for about $112,000. None of these estimates includes bottles, cases, trucks, or steam boiler.

Small hand-fed, hand-operated filling and crowning machines were widely used in the United States in the past, but are no longer economical because of low output rates and high labor requirements. A used machine of this sort could be obtained for a few hundred dollars. If many hand operations are required in a plant, it becomes more difficult to maintain high sanitary standards, however. This would apply particularly if bottles were washed by hand. The rapid growth of markets which seems to characterize this industry and the importance of making a high-quality product suggest that modern equipment should be considered at the outset.

Energy Requirements

Electric power is required for the bottling machinery, and a small steam boiler is necessary to supply hot water and steam for cleaning purposes. Both fuel and power requirements are small.

Buildings and Utilities

The equipment for the smallest bottling line discussed (see Machinery and Equipment) could be installed in about 1,000 square feet of floor space, while the largest line mentioned would require about 3,000 square feet. To these areas must be added storage space, loading platforms, office, etc., which will vary with local conditions. The building should be well lighted and easy to clean, the floor being well drained and subject to washing. There is a growing tendency in the United States to install the bottling equipment in a show window in public view. This stimulates interest in the business and emphasizes the cleanliness of the plant.

Water requirements are discussed in Raw Materials and Supplies. A bottling plant has no objectionable wastes, but drainage for considerable quantities of water must be provided.

Personnel

The smallest plant described in Machinery and Equipment can be arranged so that one man can operate the bottling line. By dividing his time between bottling, preparation of materials, etc., one man could run the entire plant, but two would ordinarily be used to provide greater continuity of operations and larger output. The number of persons required for the sales-delivery function will vary with the total output of the plant. A 300-bottles-per-minute line would require about 10 persons for actual production, plus sales and administrative personnel.

Although maintenance is not considered a major problem with bottling equipment, one or more skilled mechanics who can adjust and repair the equipment will be needed. A person with some technical knowledge of quality control problems, water treatment, and carbonation, is necessary, and if basic flavorings are to be compounded in the plant, a trained chemist would be needed. The mechanical and technical skills are often combined in the plant manager in the case of small plants.

When plants which are to bottle proprietary beverages under franchise are established, representatives of the brand owner will train operating personnel in the proper techniques.

Supporting Services

The principal supporting services which would be of value to a new bottler are those supplied by equipment manufacturers and proprietary

beverage franchisers, who will assist in the design and installation of a plant and in training the personnel. Franchisers also maintain continuing supervision and quality control inspections. Where there is an established industry, a trade association can perform useful functions in promotion, research, compilation of statistics and other useful information, etc.

Key Location Factors

The relatively high cost of distributing the beverage and recovering the empty bottles serves to locate bottling plants close to the markets they serve. A source of good water is essential, but water treatment processes afford a good deal of flexibility in this respect.

Role in Integrated Development

The great popularity of carbonated beverages in those areas in which they have recently been introduced suggests that they may be an important means for quickly affording a widespread increase in consumer satisfaction. They can be bought by persons with little cash income and may serve as incentive goods which would stimulate additional participation in the market economy.

Stability

In areas with pronounced weather seasons, the industry may be expected to have a considerable peak in the warmer months. Sales of the industry in the United States declined in about the same proportion as gross national product from 1929 to 1932. Since 1932 carbonated beverage sales have shown a substantially faster growth rate than gross national product and have been little affected by the relatively minor economic fluctuations which have occurred since that time.

Balance of Payments Effects

The industry will require an initial import of machinery and supplies. As the industry develops, local sources of supplies—bottles, syrups, crowns, carbon dioxides, etc.—may become established. The extent to which certain raw materials will always be imported will vary with local conditions. The supply situation with respect to sugar will be a major factor.

Social Aspects

The bottling plant has no undesirable social characteristics. A beverage industry producing sanitary, palatable drinks would appear to contribute to improvement in the level of living and increasing consumer satisfaction.

Experience In Other Newly Developing Countries

The industry has met with outstanding success in Mexico, the Near East, and the Orient.

SOURCES OF ADDITIONAL INFORMATION

Books, Pamphlets, Periodicals

American Bottler, monthly, 316 Peachtree Street, N. E., Atlanta 3, Georgia. $4.00. Annual Blue Book Edition contains directory of suppliers of materials, machinery, and services to the industry.

Bottling Industry, bi-weekly, 18 East 49th Street, New York 17, N. Y. $5.00.

The Chemistry and Technology of Food and Food Products, Morris B. Jacobs, ed., 2d rev. ed., Interscience Publishers, Incorporated, New York, 1951, Volume III, Chapter L.

Directory of Associate Members of the American Bottlers of Carbonated Beverages, annually, American Bottlers of Carbonated Beverages, 1128 Sixteenth Street, N. W., Washington, D. C. Available on request. Directory of manufacturers furnishing equipment and material to the industry.

The Manufacture of Carbonated Beverages, nineteen pages including bibliography, ed. and rev. by Henry E. Medbery, American Bottlers of Carbonated Beverages, 1128 Sixteenth Street, N. W., Washington, D. C., 1945.

National Bottlers Gazette, monthly, 9 East 35th Street, New York 16, New York. $3.00.

Training Course in Beverage Production and Plant, American Bottlers of Carbonated Beverages, 1128 Sixteenth Street, N. W., Washington, D. C., 1945.

Trade Associations

American Bottlers of Carbonated Beverages, 1128 Sixteenth Street, N. W., Washington, D. C.

VI. RUBBER PRODUCTS

Products

The production of crude rubber through chemical synthesis or the cultivation of natural rubber is not considered in this discussion. Natural and synthetic rubbers are available in the world market, and it is their fabrication into useful articles that is the subject of this profile.

Thousands of different items are made of rubber, and only the most general categories of products can be mentioned here. New uses for rubber are constantly being developed, together with new rubber compounds suitable for those uses.

Vehicle Tires and Tubes. This is by far the largest category of rubber products. It accounts for more than one-half of the total value of rubber products made in the United States and consumes about 68 percent of the rubber used there.

Mechanical Rubber Goods. This group includes a great variety of power transmission belts, conveyor belts, hoses, and similar items. A large proportion of the items are specially engineered for a particular use or installation and are custom made.

Industrial Rubber Products. This group includes a vast assortment of items, many of which are components of machinery, vehicles, appliances, and other products. Examples are tubing, gaskets, packing, moldings, V-belts, washers, stoppers, and special shapes.

Boots, Shoes, Soles, Heels. Specialized segments of the rubber industry of major importance.

Hard Rubber Goods. Battery cases, combs, etc.

Drug Sundries. Hot water bottles, ice bags, syringes, nipples, etc.

Floor Coverings. Rubber tile, mats, and matting.

Other Manufactures of Rubber. Gloves, erasers, sponge rubber products, toys, bathing caps, rubberized fabrics, etc.

Organization and Structure of the Industry

The major rubber companies of the United States, Great Britain, France, and Italy account for a very large share of the rubber industry throughout the world, particularly with respect to tires and heavy industrial items. About thirty countries have one or more plants which are branches or affiliates of these companies. The major companies are often integrated vertically to a considerable extent, producing natural and reclaimed rubber and tire fabrics, manufacturing rubber products, and marketing the finished products partly through their own sales outlets.

In the United States there are many small rubber manufacturing companies which specialize in items which they have developed, or for which they have special skills or marketing facilities. Special engineering services to customers frequently are provided. The particular products made by a company tend to be fixed by the market outlets which it is able to establish and serve, rather than by limitations on the production side.

The Market

The great variety of rubber products means that they are sold in many separate markets determined by the uses to which the products are to be put rather than by their rubber content. In countries at an early stage in their industrial development it is to be expected that consumer goods, such as shoes, will find larger markets than industrial goods. In an industrialized area the reverse is true.

The market for tires follows closely the use of vehicles. It has three principal aspects: supplying original equipment for new vehicles, supplying replacement tires for vehicles in service, and the recapping of worn tires. It is likely that newly developing countries will rely more heavily on motor transport and less on railroads than the older industrial areas do. The market for tires would hence be expected to expand rapidly as a transportation system is developed, even though rapid growth in the use of private cars may not be immediately anticipated.

Heavy mechanical goods such as hose and belting tend to have special requirements for each use of installation. In a newly developing country the demand for any one item is likely to be small, precluding efficient use of the skills and expensive equipment required to produce such items. The demand for industrial rubber products is directly related to the volume of other manufacturing in the area.

Boots and shoes of rubber or rubber and canvas afford low-cost footwear which finds wide acceptance in many countries. In the absence of this industry the volume of imports will be a useful indicator of the market potential.

Quality Standards

The American Society for Testing Materials and other agencies have established standards for many rubber products. Mechanical and industrial items must be designed to meet special specifications which are designed to insure the adequacy of the item for the use intended. The ability to formulate rubber compounds and establish processing techniques which yield a product meeting a given set of specifications is essential to the manufacturer in many product lines. In the case of proprietary items such as tires and shoes the manufacturer will develop his own standards to make the best possible market appeal. Uniformity of product and adherence to standard are important for all kinds of product.

Competition

The rubber industry is highly developed in the United States and other industrial countries, where a large amount of knowledge, experience, and skill in design and production of rubber products has been accumulated. Manufacturers in these countries produce many excellent products and enjoy the advantages of quantity production for a large market. Their brands and reputation have been established in many countries. A new producer may well find it difficult to compete both in price and quality of product with imported rubber goods. This is particularly true with respect to large tires, large belts, industrial hoses, etc., which represent a considerable expenditure for the buyer and in which confidence in satisfactory performance becomes more important than differences in price. A new manufacturer is likely to be most successful with articles in which quality specifications are not exacting and articles in which a price appeal is possible.

As other industries develop in a country, the local rubber manufacturer will have an advantage over foreign competitors in supplying rubber components to other manufacturers, because of his ability to consult directly with the buyer in design and to give faster service than foreign sources. To utilize this advantage he must, of course, be able to make quality products and maintain high standards.

The possibility that an established rubber company from abroad may start a branch plant or affiliated company with strong technical

resources and established brands and reputation should be explored. Such a plant would tend to produce as wide a variety of items as the market will support, within the limits of the product lines of the parent company. The great advantages of drawing on the skills and experience of an established company indicate that an affiliation or branch plant should be considered as a way to initiate rubber manufacturing in an area. This is particularly true in the case of tire production, in which the record of new independent companies has not been encouraging.

Marketing Facilities Required

Many rubber products require no special marketing facilities because of their rubber content. Marketing channels and methods depend, rather, on the end uses of the various products, tires and tubes requiring a different system from that applicable to drug sundries, for example. The marketing channels commonly employed for different types of product vary from place to place.

In the marketing of industrial and mechanical goods a sales force with technical training in rubber is required to work with customers in determining the design and specifications of products. The ability of the production staff to develop products compounded and constructed as required for these special applications is important to the selling ability of the firm, as is uniformity of product and adherence to specifications.

Manufacturing Processes

A great variety of processes are required to make the many different kinds of rubber products, and it is not feasible to describe any of them in detail here. Certain fundamental steps are involved in all of them, however, and these may be indicated.

Rubber must be mixed with chemicals and fillers which give it the properties desired in the end product. Modern rubber materials have become increasingly complex in recent years. The first step in the manufacturing process is therefore the selection of the rubber materials to be used; the second step is the determination of the formula to be used in preparing the rubber for fabrication. There are several hundred formulas in common use, and manufacturers and large buyers often develop their own formulas for special application.

Once the formula is selected, the rubber compound must be prepared for use. The rubber material selected is placed in a mixing mill, where it is softened and worked into a plastic condition, after which the other ingredients are added and mixed in proper sequence.

The prepared rubber compound is next formed into the article being produced. At this stage a variety of methods and specialized equipment are employed depending on the product. Tubing, molding, strips, etc. are extruded through a die. For many shapes the rubber is pressed into molds, often having been first extruded in suitable shape for insertion in the mold. Thin sheets are made by rolling out the rubber between the rolls of a calendering machine. Rubberized fabrics are made by calendering or by coating the fabric with liquid rubber compounds. Items such as gloves are made by dipping forms in liquid rubber compounds. Tires, hose, belts and other fabric-reinforced items are built up in layers on special forms. The fabric may first be impregnated with rubber. In garden hose and fire hose the fabric is braided onto the rubber in the rubber plant. Belting and wrapped hose are made from prewoven fabrics which may be made by the rubber company or purchased from textile mills.

The formed rubber product must be vulcanized to give it the strength, elasticity, and stability required in the finished item. This is ordinarily accomplished by carefully controlled heating, usually accompanied by pressure. This may be accomplished in a mold, an oven, or a steam retort, depending on the product. Some products are vulcanized in an acid bath.

The vulcanized product may undergo trimming or other finishing operations before being packed as a finished item.

The skill and precision with which the above processes must be carried out depend on the type of product and quality required. To meet exacting specifications the processes must be carried out with care and close control over compounds, temperatures, and timing. Each product has its special requirements in these respects. Household articles such as mats, toys, etc. allow relatively large tolerances. Rubber footwear, often crude, is relatively easy to make, and often its production has started early in less-developed countries. Canvas and rubber footwear requires a good deal of hand work and is also made in numerous less-developed areas. On the other hand, hose, belting, etc. require close control of the process, much skill, and heavy equipment.

Size of Plant

Most of the rubber products made in the United States are produced in large plants. Although there are many very small establishments, they account for a very small share of the total production. The size of a plant which could be started in a less-developed area would not necessarily correspond with that found in the United States because of differences in market size, competitive conditions, and wage rates. It is not possible to discuss here plants for all the various types of rubber products, but some factors influencing size can be mentioned.

Generally speaking, rubber-processing machinery is expensive, and its cost per unit of output capacity is less in equipment of the larger sizes, thus favoring the large plant. Technical skills are more economically utilized in a large establishment, as are laboratory equipment, management, etc.

It is estimated that tire production can be reasonably economical only in plants making at least 500 tires per day. By limiting the size-range of tires produced, a plant with daily capacity as low as 200 to 300 is probably feasible. Plants much smaller than this are found in numerous countries, but they require strong protection from the competition of imports. When the cost of producing an article locally far exceeds the price at which it could be sold if obtained abroad, the desirability of fostering the local industry should be closely examined and related to the possibility of achieving lower costs in the future. The prospect of growth in the market becomes an important consideration.

Mechanical products such as heavy hose and belting require expensive specialized equipment. Unless there is a large industrial market for these products it is unlikely that a sufficient quantity of any one item could be produced to warrant the investment required and the technical staff needed to design and produce it. However, belt-splicing, industrial hose-coupling, and similar services can be profitably performed long before manufacture of these items is feasible. Transmission-belting in standard small sizes, and simple types of rubber hose may be considered for initial manufacturing in this field.

Rubber footwear, on the other hand, can be economically produced in small plants and is favored by low wage rates. Seasonally, the rainy season demand for waterproof footwear complements the dry season demand for canvas rubber soled shoes.

Raw Materials and Supplies

New rubbers, both natural and synthetic, are available in the world market. Although rubber is the principal raw material for the industry, it frequently does not exceed 50 percent of the weight of value of a finished product. Relative prices vary, but it is not uncommon for the fabric in a tire to cost more than the rubber. In addition to cotton, rayon, nylon, and linen fabrics, the industry uses large quantities of chemicals to give rubber compounds the desired properties. A plant may stock 200 chemicals or more if it is making a variety of special-purpose rubber products. Carbon black is used in large quantities. Talc is widely used to keep unvulcanized stock from sticking together in storage or during processing. Rubber chemicals are generally available in the world market, but the manufacturer who is far from sources of these materials may find that the great variety required imposes a considerable inventory burden.

Uniform quality in the raw materials is important so that the mixing formulas can yield a uniform product conforming to specifications. In using natural rubber several grades are often mixed together to obtain uniform batches. Each batch must be tested to insure uniformity. Low-grade natural rubber must be crushed, washed, and dried prior to compounding, which necessitates additional heavy equipment in the plant if low-grade rubber is to be used.

Machinery and Equipment

The variety of machinery required for different rubber products makes it impossible to generalize on plant requirements, but some examples can be given.

Unless compounded rubber can be purchased from a nearby existing rubber plant, a mixing mill is essential. A small mill consists of two steel rolls set close together and geared to turn at slightly different speeds. The rubbing action of the rolls warms and softens the rubber and works the compounding materials into it. A common commercial size is a mill with rolls 60 inches long. It can mix a batch of 125 pounds or so in about 40 minutes. Such a mill requires an electric motor of about 150 horsepower, and complete with motor and geared drive would cost $15,000 to $20,000 in the United States. For large volume production a Banbury mixer, which is similar in design to a baker's dough mixer, is used. A large Banbury capable of mixing a batch of 600 to 700 pounds in about 15 minutes would cost approximately $75,000.

An extrusion machine, or tuber, to prepare stock for molding or to make tubes, insulation, strips, etc. will run from about $15,000 up, depending on size. A small hydraulic press capable of handling molds up to 20 inches square costs $5,000 or more, to which must be added another $5,000 for the hydraulic system. More than one press can be run from a central hydraulic system. Dies and molds for these machines must be specially made for each article to be produced and may be expected to cost from $100 to $1,000 each in the small sizes. The minimum-size calendering machine for making sheeting and coating fabrics would cost about $50,000. Steam chambers for open vulcanizing sheets and extruded material cost several thousand dollars.

Tires, belts, hose, etc. require special forms or curing molds and presses which are expensive, as well as mixing and fabric coating machines. A tire plant to make 100,000 tires a year would probably cost about $3,000,000 completely set up in a nonindustrial country.

Sponge rubber products and items made by dipping forms in liquid rubber require less equipment than other rubber products.

Energy Requirements

Rubber machinery is driven by electric motors. A small-sized mixing machine would require about 150 horsepower. In the other equipment, such as extruders, etc. the power requirements are much less.

A source of heat, usually steam, for vulcanizing is required in practically all rubber plants. However, fuel requirements are relatively small.

Buildings and Utilities

A rubber plant must be adequately sheltered in a factory building with good ventilation and light. The machinery is heavy and needs strong foundations. A highly specialized type of building is not required.

In addition to the electric power mentioned above, water is the chief utility service required. Water is needed both for steam and for cooling purposes in the mixing machines. If water is expensive, a cooling tower for the recovery of water will be necessary.

Personnel

Labor. The labor skills required vary a great deal with the nature of the rubber products being made and the equipment provided in the plant. Hose and belting require highly skilled workers. Tires require similar skill if a complete tire is to be built by one man on a revolving drum. However, the tire-making process can be divided into steps, with each man performing only one step, in which case the workers can be rather quickly trained for their specialized tasks. Rubber mixing requires care and close attention in any type of plant.

Extruding and molding machines can be run by semiskilled operators under the supervision of experienced rubber men.

Skilled mechanics for maintenance work on equipment are needed. Toolmakers to produce molds and dies are needed when these items are used, although this work may be done outside the plant.

Technical. A rubber chemist is required to provide the formulas for mixing rubber for different products and to handle testing and quality control in the plant. Experienced rubber men who have acquired a good deal of technical knowledge of the business should be used in supervisory positions. Rubber is not an easy material to process successfully for any use in which specifications or high performance characteristics are important, and persons with practical experience in the industry will be essential. A technically trained sales force, even including engineers, is necessary for the more complex industrial and mechanical products.

Supporting Services

Custom mold and die makers offer a valuable service for small plants which cannot utilize the full time of a skilled toolmaker. Where the industry is highly developed there are consulting engineers and rubber experts who can give valuable assistance, but in general the industry is typified by large companies which tend to be self-sufficient in technical services. The accumulated "know-how" in a large company is very valuable in starting branch plants or affiliated companies in other areas.

Key Location Factors

The costs of power and water, the availability of the necessary labor skills, and the transportation costs for raw materials and

finished products are all important factors in the location of a rubber plant. For industrial products nearness to the manufacturers who use rubber articles and components is of major importance.

The tire industry in the United States started in Ohio by chance, although the above factors were relatively favorable there. As the industry grew, the availability of skilled rubber workers in Ohio was a strong factor in encouraging expansion in that area. Recently, nearness to consuming markets has become the most important location factor for new plants, as raw material can be assembled for about the same cost in all the major market areas, and new production methods have made it possible to use quickly trained labor.

Role in Integrated Development

Industrial and mechanical rubber goods are essential to the industrial growth of an area. Local production of these items, however, may be expected to follow the growth of other industries rather than to lead it. This is because other industries can secure their rubber products from abroad so that their development is not held back by lack of rubber, while a substantial market is necessary to support local production of these rubber products. The same may be said of vehicle tires and tubes. To start these phases of the rubber industry in an area before a satisfactory market has developed may lead to the commitment of resources which could be better employed in other lines.

Newly developing areas are likely to have an existing and growing demand for consumer goods made of rubber--footwear, rubberized fabrics, household articles, novelties, etc. The provision of such products at favorable prices would contribute to a rising level of living and also generate income and employment. Through the manufacture of articles for which there is sufficient demand to support plants of economical size, the rubber industry can be a stimulus to further economic growth.

Stability

Various rubber products may be expected to have seasonal sales patterns depending on the use of the product and the weather cycle of the area. For example, a rainy season may cause tire sales to decline while rainwear and rubber boot sales increase. Each product requires individual analysis.

In general, rubber products may be expected to reflect over-all changes in the volume of industrial production, employment, and

incomes in the area. Some products will be more sensitive than others to economic fluctuations. The end use of the product and the other items with which it is combined in use must be considered in estimating the effects of changes in economic activity. Tires for original equipment on new cars, for example, show greater fluctuations in sales than tires for replacement use or camelback for recapping worn tires.

Balance of Payments Effects

It is not likely that rubber products will become an export item for newly developing areas. The technical resources and advantages of size enjoyed by the established companies in industrial areas will make competition in the export market very difficult. Even for articles like footwear and toys the competition of Japan and other low-cost producing areas will be hard to meet.

To the extent that imports are replaced by local production there would be a tendency for a favorable effect on the balance of payments. This will be offset at least in part by the necessity to import raw materials in most areas and the need to import rubber working machinery. If the new industry is a branch of a parent company in another country, remittances of profits to the parent company must be considered. To the extent that locally produced articles make possible wider consumption of rubber goods in the area the need to import raw materials would exert a further unfavorable pressure on the balance of payments. Unless local supplies of natural rubber and fabrics can be utilized it does not appear that a rubber industry would contribute much to the improvement of the balance of payments position. In India and Brazil, the domestic price of locally produced rubber is maintained above world market prices by government regulations.

Social Aspects

A rubber plant should not create any particular problems for the community.

Experience in Other Newly Developing Areas

Philippines. Rubber manufacturing started in the Philippines in 1933 with a rubber shoe factory. "There are at present seven rubber shoe factories... Many other articles are being produced such as tubing, gloves, ice and hot water bags, overshoes and rubber boots. The manufacture of automotive tires is being initiated and some success has been reported. As far as can be determined large-scale production has not yet been possible. There have been

established also facilities for the recapping of old tires, most of these by the local agencies of American tire manufacturers. Camelback, an unvulcanized retread stock for recapping is one recent addition in the list of rubber goods being turned out. Most of the establishments which went to the manufacture of miscellaneous rubber goods were those already engaged in the production of rubber shoes."[1/]

Colombia. In 1949 some 21 establishments were manufacturing rubber products, two of them producing tires and tubes. One of the tire companies is a subsidiary of an American tire company; an American company is a major stockholder in the other. The manufacture of rubber-soled shoes is next in importance to tires, and other items are rubber heels, rubberized cloth, tubing, industrial packings, and camelback. The industry is dependent on imports for a substantial part of its raw materials. Manufacturers are required to purchase specific amounts of native rubber, but the supply is inadequate, and the price is more than twice that of imported rubber.[2/] The industry is protected by tariffs.

Venezuela. Tires and tubes are produced by a subsidiary of an American tire company, but protection against imports is required to keep this operation going. A quota system is used. The plant also produces rubber bath mats, floor tile, and foam rubber. Two other American rubber companies have processing facilities for other rubber products, including camelback. There is substantial production of rubber footwear, which also receives protection from imports.[3/]

1/ Industrial Philippines, Philippine Council for United States Aid, Industrial Development Branch, Manila, 1953, pp. 165-6.

2/ Investment in Colombia, U. S. Department of Commerce, GPO, Washington, 1953, pp. 96-97.

3/ Investment in Venezuela, U. S. Department of Commerce, GPO, Washington, 1953, p. 128.

SOURCES OF ADDITIONAL INFORMATION

Books, Pamphlets, Periodicals, etc.

Ball, John McNickle, Reclaimed Rubber: the Story of an American Raw Material, Rubber Reclaimers Association, New York, 1947. A detailed discussion of methods by which scrap rubber, old tires, etc. can be processed for re-use.

Handbook of Molded and Extruded Rubber, Goodyear Tire and Rubber Company, Akron, Ohio, 1949. Description of processes, engineering qualities of products, etc. Illustrated in some detail.

India Rubber World, monthly, 386 Fourth Avenue, New York 16, N. Y., $3.00.

Rogers, S. S., ed., The Vanderbilt Rubber Handbook, 9th ed. R. T. Vanderbilt Co., New York, 1948. Discussion of many rubber manufacturing methods and problems likely to be encountered. Emphasis is on use of chemicals made by the Vanderbilt Company, but coverage is quite broad, and there are articles by numerous persons not connected with the company.

Rubber Age, monthly, 250 West 57th Street, New York 19, N. Y., $3.00.

Rubber Red Book, published biennially by Rubber Age. A complete directory of the U. S. rubber industry--manufacturers, suppliers, etc. $10.00.

Seaman, Robert G. & Arthur M. Merrill, Machinery and Equipment for Rubber and Plastics, India Rubber World, New York, $15.00 in U. S., $16.00 elsewhere.

Trade Associations

Rubber Heel and Sole Manfacturers Association, 551 Fifth Avenue, New York 17, N. Y.

Rubber Manufacturers Association, 444 Madison Ave., New York 22, N. Y.

Rubber Reclaimers Association, 250 West 57th St., New York 19, N. Y.