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BULLETIN

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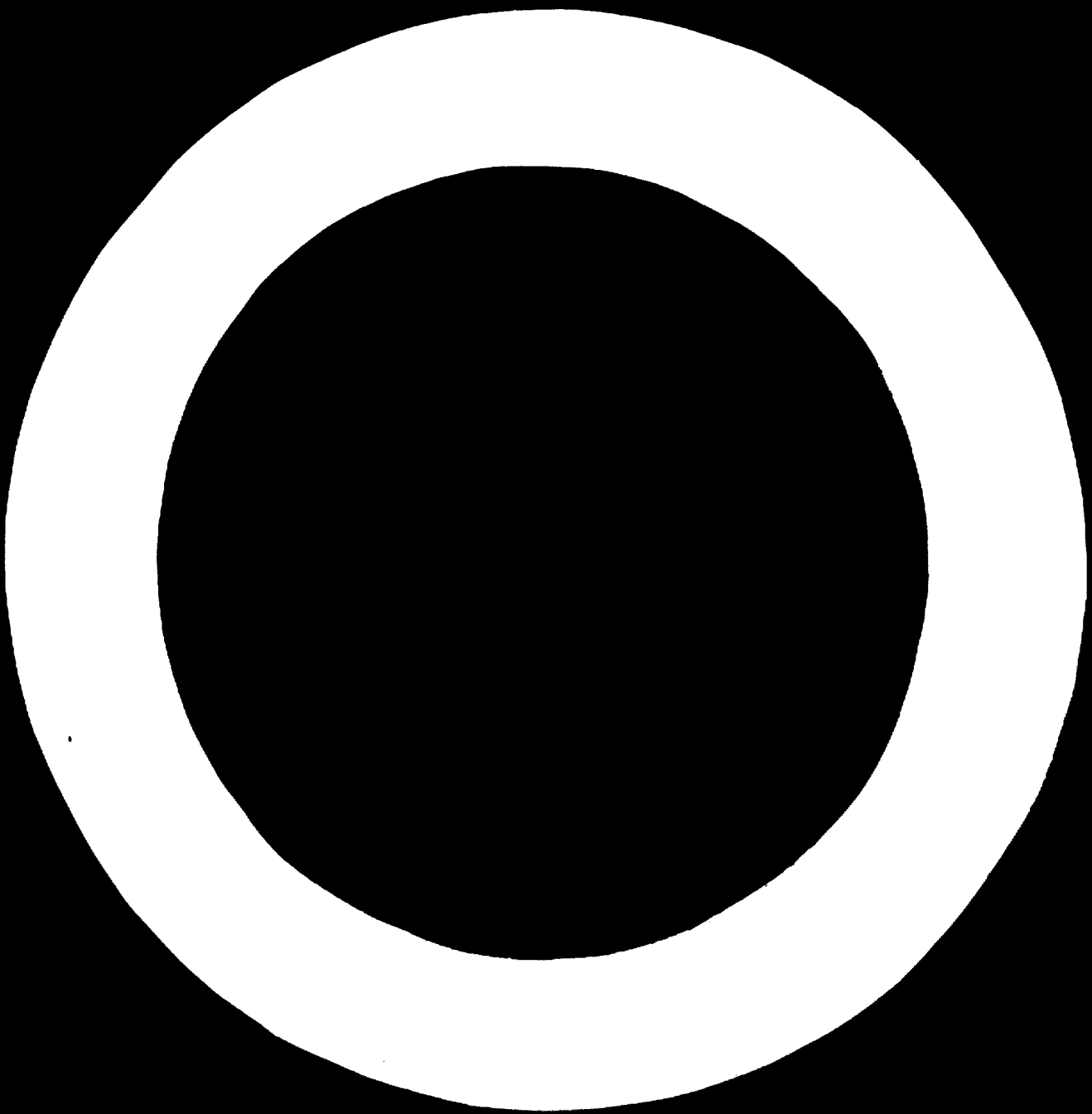

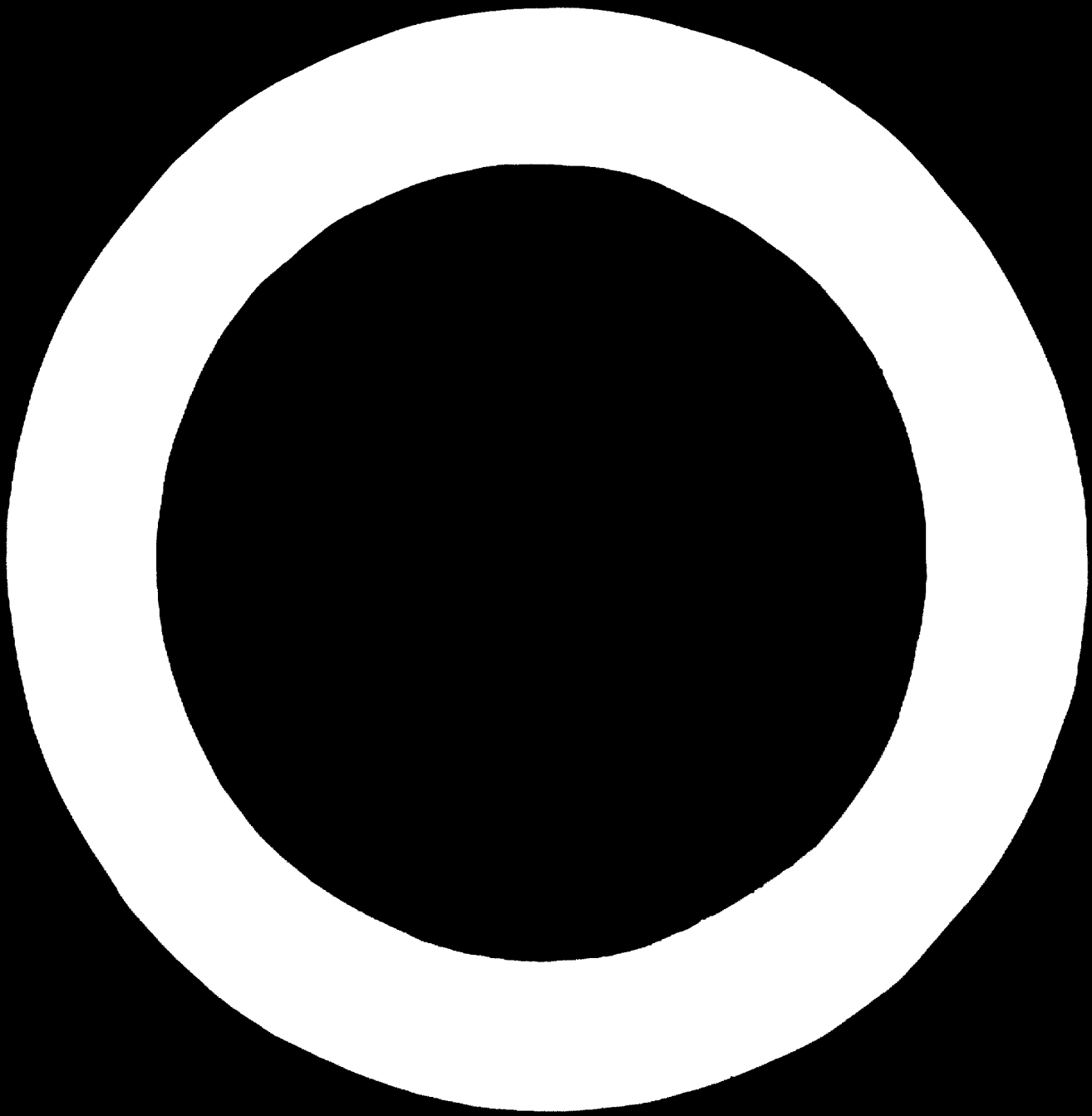

INDUSTRIALIZATION AND PRODUCTIVITY

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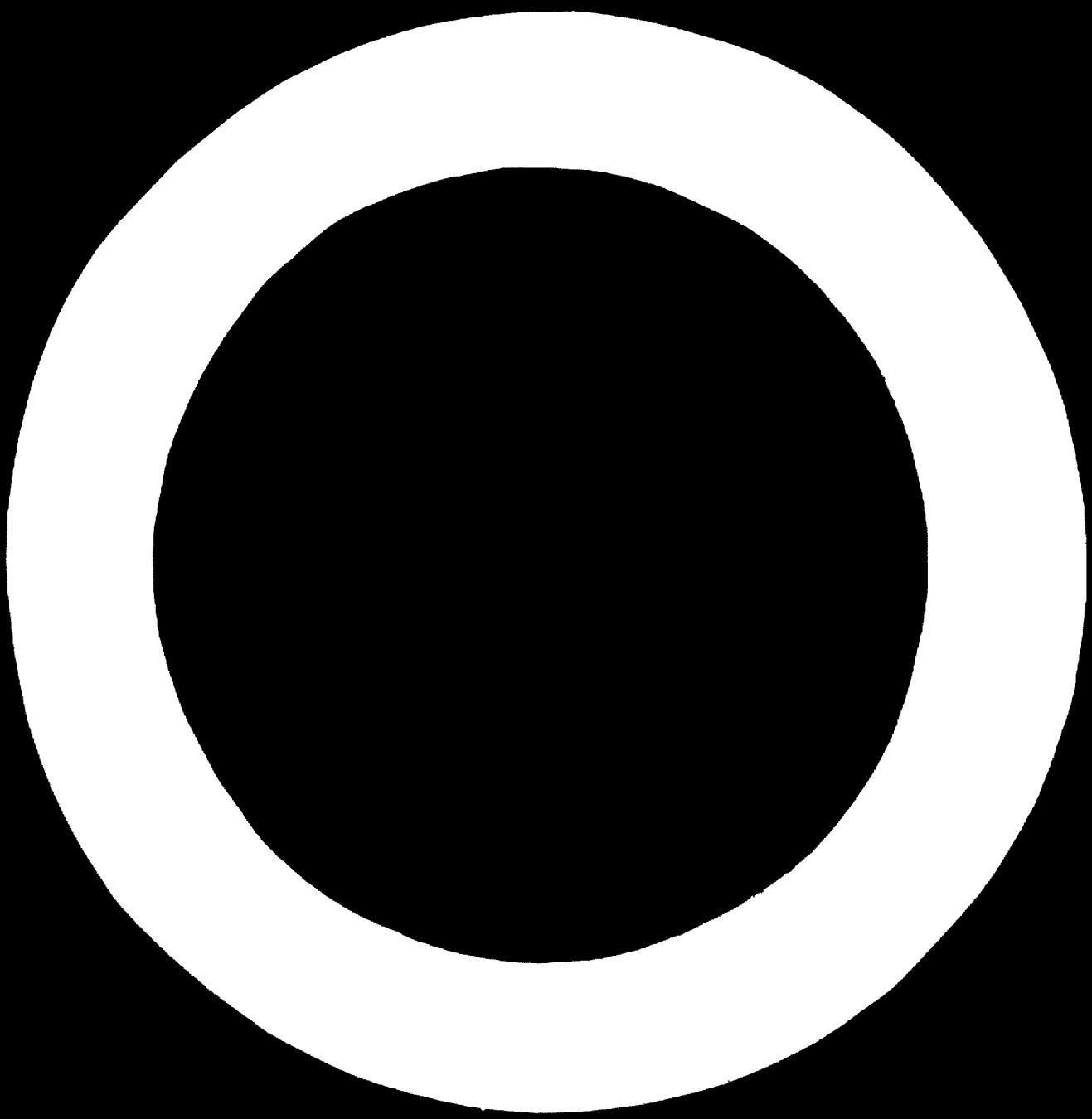

In this issue

Cover illustration: Inspection of automobile spark plugs to detect visual defects as a part of a series of tests prescribed by an Indian standard specification. An article in this issue discusses the need for standardization in a developing economy.

Department of Economic and Social Affairs

INDUSTRIALIZATION AND PRODUCTIVITY

BULLETIN 7

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Preface

THE ARTICLES AND bibliographical material contained in this issue of the *Industrialization and Productivity Bulletin* are concerned with a variety of subjects in the field of industrial development—planning and programming, capital intensity, standardization, financing and health aspects of industrialization. Planning and programming is the main subject or a closely related topic in most of the articles, some of which are revised versions of papers prepared for a Seminar on Industrial Development Programming in the Latin American Region, organized by the United Nations and held in São Paulo, Brazil, from 4 to 15 March 1963.

The article entitled "Projection of Demand for Industrial Equipment" is aimed at evaluating, for planning purposes, the level and composition of demand for equipment in selected major sectors of manufacturing industry in the developing countries in relation to the expected trends in production of the equipment producing industries in these and the developed countries, in the next ten to fifteen years.

The purpose of the next article, "Choice of Capital Intensity in Industrial Planning", is to evolve some operational criteria for selecting the appropriate "factor-mix" in planning the development of industry as a whole, of its main sectors, and of individual industrial projects at both the construction and operation stages.

Both articles are based on papers submitted to the above-mentioned Seminar on Industrial Development Programming. In a brief note, information is given on the work and conclusions of this meeting, which was concerned with over-all planning and policies, sectoral planning, evaluation of projects, and programming or pre-investment data.

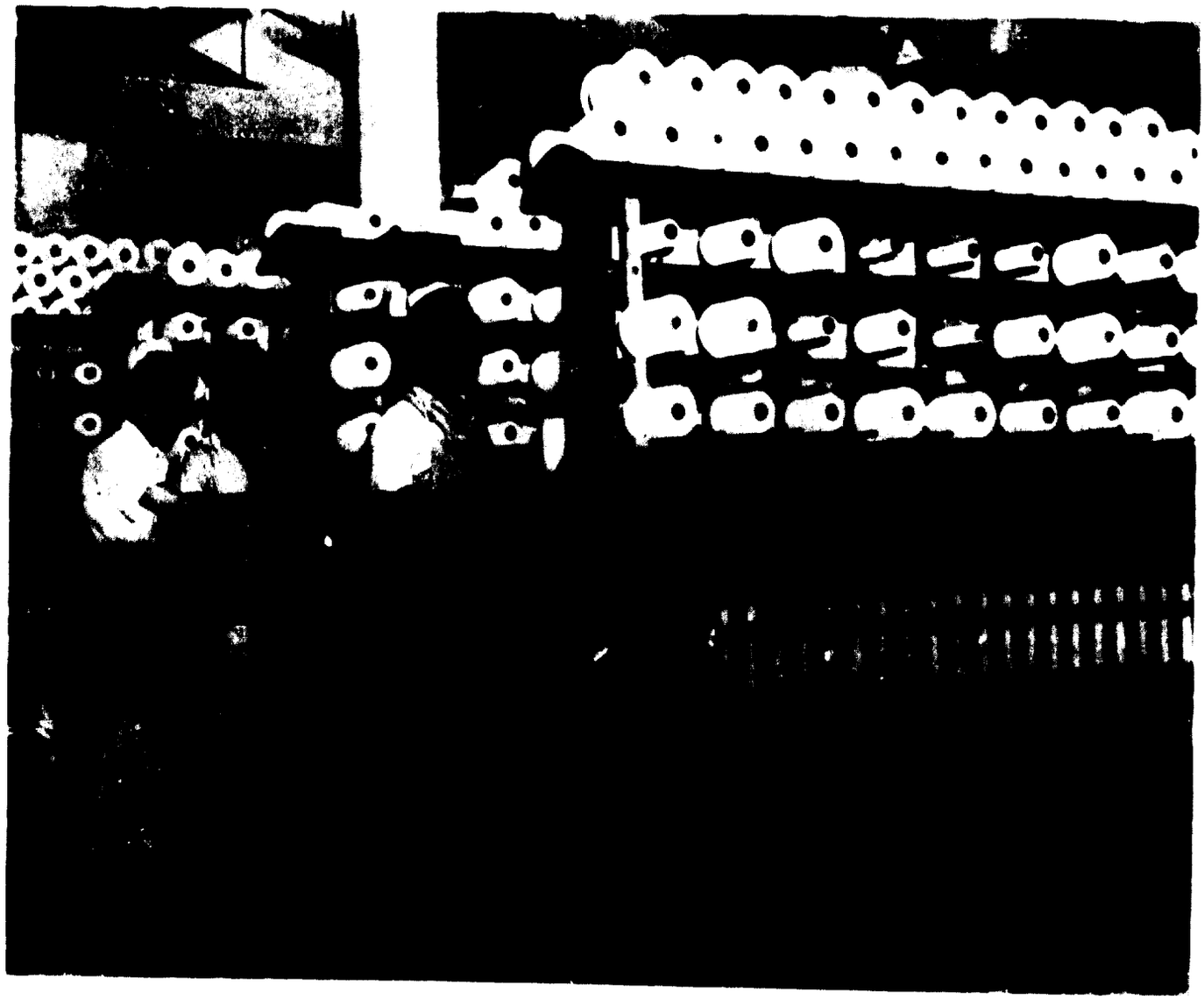
In an article on "Standardization in a Developing Economy", Mr. Lal C. Verman discusses the need for standardization in the industrializing countries, particularly in the context of development plans and programmes, the applicability of the knowledge and practice acquired in the advanced countries to the conditions prevailing in the less developed ones, and the organization of standardization at both the national

and international levels, against the background of the Indian experience in the past fifteen years.

Problems of development financing are discussed in an article on "The Inter-American Development Bank and Industrial Development in Latin America", by Mr. John W. Delaplaine. The article reviews the policies, procedures and methods of operation in the field of industry applied by this recently created financial institution to stimulate the economic and social development of its nineteen Latin American member countries. Sectoral planning and project programming are among the subjects discussed in the article, which is based on a paper submitted to the São Paulo Seminar.

Finally, the issue contains a bibliography on "Health Aspects of Industrialization" compiled by the World Health Organization, which provides a selected list of books and articles from periodicals published in the period 1951 to 1962.

All articles, except the two signed articles and the bibliography, were prepared by the Research and Evaluation Division of the Centre for Industrial Development, Department of Economic and Social Affairs.



Training workers to operate an imported spinning machine in a mill at Gatooma, Southern Rhodesia

Projection of Demand for Industrial Equipment

THE PRESENT STUDY *deals with the requirements of the developing countries for equipment and machinery in the next ten to fifteen years. The projections cover only the demand for industrial equipment by the manufacturing sector. They are derived by the application of equipment/output ratios in major groups of manufacturing to the estimates of output of the corresponding groups. The latter were in turn based on projections of population and income as well as on the parameters of growth developed in United Nations,* A Study of Industrial Growth *(Sales No.: 63.II.B.2), prepared by the Research and Evaluation Division of the Centre for Industrial Development, Department of Economic and Social Affairs, in collaboration with the Research Centre on Economic Growth of Stanford University, California.*

The study was presented to the Meeting of Experts on Capital Goods Requirements organized by the Economic Commission for Europe (ECE) in Geneva in February 1962. It complemented the study prepared by the Commission entitled Production and Export of Mechanical and Electrical Engineering Goods *(Sales No.: 63.II.E/Mim.12).*

INTRODUCTION

WITH INCREASING ATTENTION being given to the need for the development of the economically underdeveloped areas, concern has been expressed over the magnitude of the resources, human and material, required to achieve the expected increases in income in these countries. A number of studies have been undertaken by various international and national groups for the purposes of estimating these requirements in terms of major economic categories such as domestic capital formation, capacities to import and the development of export markets, and the required levels of foreign assistance.

The study of the international implications—the global impact—of national development programmes has been facilitated by the recent trend toward the preparation of longer-term national economic programmes in underdeveloped countries. While the scope and nature of these programmes vary in view of the different economic and social systems prevailing in the countries concerned, nevertheless, certain basic aggregative economic data which are reasonably comparable are supplied for many countries.

At the present time, considerable emphasis is being given to the role of industrial development in the longer-term pattern of growth. There is no necessity in this study to examine the various reasons why priority is attached to growth in that sector; it is sufficient to take note of that tendency. The programme of work of the Committee for Industrial Development has been drawn up with a view to obtaining information on and studying a certain number of major problems arising in the process of industrialization of the developing countries.

Among the areas of studies are the structure and sequence of growth of industry and projection of requirements in industrial equipment of industry by major industrial branches in relation to this growth. The two studies are closely interrelated: the first is briefly described in section II of this article and provides the statistical basis for the projections of the second.

The present study, which deals with equipment requirements, is an attempt to derive a certain number of minimum equipment data related to the growth of major sectors of manufacturing industries in the developing countries in the next ten to fifteen years which, it is believed, might be useful for both the developing countries which are concerned with the magnitude of the prospective demand and the industrial countries which are the major source of supply of investment goods.[1] For the purposes of this study, investment requirements have been broken down into two major categories: equipment and construction. It is well known that construction requirements for industrial plants can, for the most part, be met from local resources; moreover, these requirements may vary considerably from country to country, in relation to local conditions. On the other hand, equipment requirements are less likely to vary in relation to local conditions, being determined basically by the technology used. It is anticipated that in the period under review the major part of the requirements for manufacturing equipment proper, which constitute over 80 per cent of the manufacturing industries' equipment demand, will continue to be met by imports. While some increase in local production of equipment may be expected in certain of the more advanced among the developing countries, it is not likely that this source of supply will meet the bulk of requirements for manufacturing equipment proper in the next ten to fifteen years.[2]

In projecting equipment requirements for manufacturing industries in the developing countries, it is important to take into account the fact that manufacturing is only one of the sectors which uses the output of the mechanical and electrical engineering industries. It is estimated that manufacturing equipment proper imported by underdeveloped countries represented 28 per cent of the total value of machinery and transportation equipment imported by these areas in 1953. The recent growth in investment programmes in industry has resulted in an increase in this share, and by 1958 and 1961, it had risen to about 33 per cent (see table V of the appendix).

The importance of these imports from the point of view of the supplying countries can be seen from the fact that in 1958, exports of manufacturing equipment proper to the under-developed countries were estimated to represent about 10 per cent of gross output of these items in the industrial countries. Among the western European countries, the share appeared to be over 20 per cent for the United Kingdom, while it exceeded 15 per cent for the Federal Republic of Germany.[3]

The first step of the analysis which follows is to estimate the level of total requirements of equipment in relation to the anticipated increases in manufacturing output in the period 1970-1975. The method of projecting these various magnitudes is discussed in detail in section II below. In brief, on the basis of a study of factors determining the structure of industry, the level of output is projected for selected major sectors of manufacturing industry for under-developed countries as a group. Equipment requirements per unit of output, as estimated from a detailed analysis of the United States economy, are then applied to these sectors in order to determine the level of total requirements and its composition; an estimate is made at the same time of the magnitude of equipment required for replacement of the existing stock of capital. These requirements are finally analysed in terms of their composition by broad categories of equipment.

It is recognized that the application of equipment requirements based on present or recent United States practice has many shortcomings; clearly if one were concerned with particular situations such as an investment programme for a specific country, these data would have to be supplemented by more detailed analysis. Moreover, modern industry is characterized by a rapid rate of technological changes, so that the requirements for many individual industries may undergo rapid changes in the next decade. Nevertheless, for the purpose of arriving at broad orders of magnitude and as a first approach to the problem, pending availability of better data,[4] it is believed that the application of the data from United States sources is justified.

As to the usefulness of the present data, which are segregated by major industrial categories, a first question which arises is to what extent the production programme of a machine-building industry with given production capacity is flexible in response to changes in demand for products or groups of products. It is clear that analysis of demand, to be realistic and meaningful for

[1] The present study takes into account only imports of equipment from western Europe, the United States, Canada and Japan. Imports of equipment from the centrally planned economies are omitted for statistical reasons. The Union of Socialist Soviet Republics does not use the Standard International Trade Classification (SITC) and their exports of capital goods are included in "complete industrial plants". Shipments of equipment from centrally planned economies to newly developing countries appear to have increased substantially in recent years.

[2] A distinction is made between total demand for equipment by manufacturing industries and that component which represents machinery used exclusively or principally by manufacturing. This distinction is dealt with in detail later on.

[3] Estimates of gross output in the industrial countries were made by the Centre for Industrial Development on the basis of national manufacturing censuses for 1958 and earlier years. Exports of manufacturing equipment proper, which represent selected items of SITC 71, non-electrical machinery, were compiled from foreign trade statistics, published by the United Nations. The difficulties in defining equipment with sufficient precision to permit measurement, and the obstacles in matching trade with production statistics are discussed below.

[4] A continuation of the study on equipment requirements is contemplated by the United Nations Centre for Industrial Development, in co-operation with the regional economic commissions.

this industry, will have to proceed on a level of aggregation which takes into account these technological characteristics. This problem was explored in co-operation with a technical group in the Economic Commission for Europe (ECE).

It should be kept in mind that the level of aggregation of equipment used in the present study is in part accidental; it is based on a classification of equipment adopted in the input output analysis of the United States economy referred to above.[5] In addition, since the statistical analysis is based on data derived from another study carried out under the United Nations programme,[6] the level of industry aggregation was necessarily determined by the classification adopted in that study. An attempt to re-evaluate the data on a different basis would be very expensive, and it should be considered to what extent an alternative classification is likely to yield sufficiently improved results.

The details of the various techniques used in the projections are discussed in the main body of this study. It is considered useful, however, to present briefly at this point the statistical framework within which this analysis is being conducted. In projecting the level of total industrial output and output by major categories, industry has been classified into thirteen major sectors, a break-down which is dictated by the availability of internationally comparable data originating from national censuses of production.[7] These thirteen sectors are based upon the twenty two-digit groups of the International Standard Industrial Classification (ISIC) into which the category of "manufacturing industry" is subdivided. Because of statistical problems connected with national classifications, it was found expedient to combine some of the two-digit groups; a list of the groups with an indication of the components is indicated in the statistical appendix table III. Equipment requirements, which are based upon the data from the United States study, are classified in terms of the United States Standard Industrial Classification which corresponds very closely to ISIC; in that source the definitions of industries —users of equipment —followed the same classification, considerably simplifying the statistical problems involved.

Industrial output is measured in terms of value added by manufacturing. This is actually a measure of generated income which corresponds roughly to the gross domestic product component in national accounting. It is used as a measure of output since it has the advantage of avoiding problems of duplication due to inter-industry purchases which arise in working with the concept of gross value. On the other hand, gross value at the factory is used for the value of the equipment, since it is the purchase price of equipment that enters the computation of investment.

Unless otherwise specified, all value data are given in constant 1953 prices. The foreign trade data have been converted into United States dollars at the official exchange rates. The output data have been converted into United States dollars using estimated parity rates. For the details of the computations the reader is referred to the publication cited in foot-note 7.

[5] Unpublished material made available by the Harvard Economic Research Project.

[6] United Nations, *A Study of Industrial Growth*, carried out in collaboration with the Research Centre on Economic Growth in Stanford University, California.

[7] The data are taken from United Nations, *Patterns of Industrial Growth, 1938-1958* (Sales No.: 59.XVII.6). For details on adjustments of the national data to provide international comparability, see the introduction to that publication.

I. EQUIPMENT/OUTPUT RATIOS

DESCRIPTION OF THE RATIOS

THIS SECTION IS concerned with an examination of the data on equipment requirements for individual industries which are used in the projections. The basic technique is to determine for the selected industry groupings the value of equipment which is necessary to produce one unit of output. This ratio, which shall be called the equipment/output ratio, is then applied to the estimate of industrial output in order to determine total equipment requirements.

The most important problem in this connexion relates to a precise definition of the ratio. Three types of capital/output ratios—or a component part, the equipment/output ratios—have been defined in the literature on this problem and have been used for various purposes; they are as follows:

(*a*) Net average capital/output ratio: defined as the depreciated value of the existing stock of fixed assets used to produce one unit of annual output;

(*b*) Gross average capital/output: defined as the undepreciated value of the existing stock of fixed assets used to produce one unit of annual output;

(*c*) Marginal capital/output ratio: defined as the value of new investment which is needed to produce one additional unit of annual output.

For projection purposes the average ratios are less appropriate since it is obvious that the process by which the capital stock has accumulated over time is not relevant to the new investment which will be needed for increasing production.[8] What is needed for this purpose, therefore, is the marginal ratio.

In preparation for this study, a survey of the literature on this topic was conducted in order to obtain estimates

[8] In addition, the net average ratio, where capital values have been adjusted to exclude depreciation, is not a satisfactory measure of investment requirements.

of marginal capital/output ratios for industries which would include a break-down of capital requirements into equipment and other items. Capital/output data for industrial groups exist for a few of the more industrially advanced countries; however, some of these data refer to the average ratios while others do not have break-downs of capital requirements. For under-developed countries, little information is available on this matter on a sufficiently broad scale; scattered data are available only for a number of individual plants in certain industries.

The most extensive study of data bearing on the problem of equipment requirements for expansion of output was prepared recently on the United States economy. As will be apparent in the discussion which follows, these data do not completely conform to the definition of marginal ratios presented above. The data represent, however, a complete set of such ratios covering the manufacturing industries which have been prepared on a common statistical base. Moreover, the statistical base corresponds to the one underlying the study on industrial output. For a number of individual sections or commodity groups, more refined data have been prepared in other studies, but there are numerous difficulties in converting these data for application to the available output data.

A study of the structure of the economy of the United States in 1947 was undertaken by the Harvard Economic Research Project, under the direction of Professor Wassily Leontief. In addition to presenting the familiar static input output or flow matrix setting out inter-industry relationships for current output, this study provided a dynamic model setting out capital requirements for the expansion of output in each of the producing sectors. More precisely, data are given for each sector indicating the value of all inputs (investment) which are needed to provide the "normal annual capacity" to produce one dollar of output,[9] all values expressed in 1947 prices. This model contained 192 sectors, of which some 145 are manufacturing industries; the classification of both inputs and outputs was based on the prevailing United States Standard International Classification which is, as noted earlier, roughly comparable to ISIC. The basic material underlying this study has been made available by the Harvard Group.

The sources of the capital input data for this study were rather varied. A considerable portion was based on data submitted to the United States Government by firms which undertook investments in new plant and equipment in individual industries in the emergency mobilization after 1950; these reports listed in various degrees of detail the components of planned expenditure. Under the definition given above, these data correspond to marginal ratios.

Some estimates were based on capital inventory figures and, in a few instances, on adjusted balance sheet data; estimates using these data would correspond to average ratios. It should be noted that since the main objective was to provide marginal ratios, preference was given to data based on actual or planned new investment and it appears that adjustments were made, in some cases where other types of data were used in order to approximate the first type.

In the Harvard study, the data were given in 1947 prices. Since all of the data which are to be used in drawing up the projection of equipment demand in the present study are based on 1953 prices, it was necessary to put these ratios on the same basis. This was done through the use of special price indices made available by the United States Department of Labor. In addition, in the model, output was expressed in terms of gross value (or sales value at the factory); adjustments have been introduced to express output in terms of value added, using for each sector the relationship between gross value and value added as resulting from the data in the 1954 census of manufactures.

The definition of equipment used in these computations corresponds to items appearing in ISIC 36-38 which correspond to SITC divisions 71-73. The results of these computations are shown in table 1. The figures in the table indicate the amount of equipment needed to give rise to one dollar of value added in the individual industrial sectors. In general, the relationships among the ratios for the individual sectors correspond to expectations; the clothing and leather industries are capital extensive, that is, use little equipment, and this is reflected in the relatively low figures for these industries. On the other hand, basic metals and petroleum refining, which involve highly mechanized processes, are the highest on the list.

Of particular importance is the rather narrow range of variation in the thirteen sectors, particularly as compared with published data on the ratio of total fixed assets to value added for certain countries. This may reflect, in part, statistical averaging; it is well known that aggregating a large set of data into a smaller number of groupings tends to reduce the range of variation, that is, the difference between the lowest and highest entry in the set. In addition, the original data also suggest that there is considerably more variability in construction requirements than in equipment requirements among sectors. (This is also apparent from table 1.)

Application of the data to the conditions of the under-developed countries

For the purpose of projecting demand for equipment in under-developed countries, it is planned to use the equipment/output ratios obtained from the United States data. As mentioned before, the weaknesses in this procedure are manifold; nevertheless, in the absence of direct data from the under-developed or even other developed countries, there is no alternative. In the remainder of this section, it is proposed to set out some of the factors which have to be considered in order that the estimates used in these data may be appropriately evaluated.

[9] This is simply the result of dividing the values of investment inputs by the expected normal annual capacity of the new plant.

Table 1

INVESTMENT REQUIREMENTS IN EQUIPMENT AND CONSTRUCTION FOR THE EXPANSION OF OUTPUT IN MANUFACTURING SECTORS, BASED ON UNITED STATES PRACTICES

(Investment per dollars of value added in dollars at 1953 prices)

Major group	*Equipment*[a]	*Construction*
Food, beverages and tobacco	0.41	0.40
Textiles	0.51	0.40
Wood and wood products	0.39	0.39
Pulp and paper	0.65	0.48
Printing and publishing	0.42	0.24
Rubber	0.44	0.26
Leather	0.19	0.24
Clothing (including furs)	0.20	0.18
Non-metallic minerals	0.51	0.67
Chemicals and petroleum products	0.63	1.30
Chemicals	0.54	0.35
Petroleum	0.94	4.70
Basic metals	0.92	1.42
Metal products	0.51	0.32
TOTAL[b]	0.52	0.57

Source: Compiled on the basis of unpublished material supplied by Harvard Economic Research Project.

[a] The total equipment used by manufacturing industries consists of over 80 per cent of non-electrical machinery (manufacturing equipment proper); the rest is made up of machinery and equipment for which manufacturing is only a marginal consumer. For a break-down of the equipment requirements by manufacturing industries, *see* appendix table IV.

[b] This total is the weighted average for manufacturing industry in the United States in 1947. In view of the differences in the structure of manufacturing industry in under-developed countries, the over-all ratio is expected to be different for the latter.

Technology

The data on equipment requirements described above reflect the state of technology of the industrially advanced countries. In these countries, with relatively high labour and low capital costs, it may be expected that the technology will tend to be capital-intensive. In applying these data to under-developed countries, it is therefore necessary to take into account the possibility of re-appraising capital requirements in the light of the particular economic conditions of these countries. In view of the factor endowment in most under-developed countries, namely, a relative labour surplus and capital shortage, one may expect, at least theoretically, some reduction of equipment requirements through substitution of labour in the production process. If this tendency had indeed been followed in the industry of under-developed countries, this would result in an equipment/output ratio lower than that found in the advanced countries and smaller over-all requirements. There are, however, indications that actual practice in the industry of under-developed countries consists in the use of technology where substitution of capital by labour is of a very limited scope.

Considerable discussion has taken place in the literature on the possibilities of such substitution, and the United Nations Secretariat has engaged in certain studies on this point.[10] In the first place, it appears that in many process-type industries, such as chemicals, cement and metal refining, the existing technology leaves little leeway for the substitution of labour for capital in the main elements of these processes. There is no doubt that in these industries, in ancillary operations such as materials handling,[11] packaging and transport, there exist many possibilities for labour use which, from the point of view of employment, represent important areas for more intensive labour utilization; whether, from the point of view of equipment requirements, the capital savings which could be achieved through such substitution would be of any considerable significance is not certain at this point without further exploration. With respect to other industries, such as metal fabrication, information on capital labour substitution possibilities is scant and inconclusive; further research is also needed on these aspects.

In the second place, consideration should be given to the possible future trend in technological developments which may affect these ratios. It is obvious that a detailed analysis of this problem is beyond the scope of this study. Nevertheless, it is possible to make a few observations. Among industrialized countries, the principal technological trends in the past have been in the direction of cost reduction through reducing labour inputs, raw material or fuel inputs; the consensus of investigations conducted so far is that in the main these savings have been achieved at the expense of greater capital inputs per physical unit of output.

In recent years, however, certain technological improvements have been introduced which are significantly capital-saving. One of these which has attracted considerable attention because of its potentiality with regard to under-developed countries is the development of electrical processes for iron and steel production.[12] Another is the growing use of cast aluminum as a substitute for iron or the replacement of metals by plastics in a number of final products; in these instances, equipment requirements to utilize the new raw materials in the production processes appear to be significantly less than in the older techniques. Reference may also be made to the use of

[10] *See*, for example, the series of studies dealing with this problem in the *Industrialization and Productivity Bulletin* Nos. 1, 3, 4 and 6.

[11] Earth-moving, which might be considered a special category of material handling, has been dealt with in two articles appearing in the *Industrialization and Productivity Bulletin*, Nos. 1 and 3. *See* also the study on "Choice of Capital Intensity in Industrial Planning" published in the present *Bulletin*.

[12] These are also desirable for under-developed countries in that they reduce the need for certain raw materials which are in short supply in these countries. For a discussion of this matter, *see* United Nations, *Long Term Trends and Problems in the European Steel Industry* (Sales No.: 60.II.E.3), chapter IV. *See* also the report of the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas held in Geneva in February 1963, to be published in a series of eight volumes; *see* in particular volume IV, *Industry* (Sales No.: 63.I.24).

welding techniques in place of large, mass castings of iron and steel products, which tends to reduce capital requirements.[13]

In the third place, it should be kept in mind that the equipment requirements used in this estimate correspond to the scale of output which predominates in the United States. There is ample evidence that the scale of operations of individual plants in under developed countries will be somewhat lower than in the United States or the other advanced industrial countries owing to well known market limitations. In view of the observable economies of scale, particularly with respect to equipment requirements, this factor would tend to raise these requirements per unit of output as compared to those used in this study.[14]

There are other factors at work in under developed countries which tend to raise the capital output ratio and which appear to more than offset whatever substitution of labour for capital takes place.

Among these factors, the generally lower levels of performance of equipment in the newly developing countries tend to increase the amount of equipment which is needed per unit of output as compared to the older industrial countries. To quote an earlier study by the United Nations Secretariat on the differences in the rate of utilization of equipment and in job performance in under developed countries as compared to the advanced countries "... In countries with a long industrial history, the necessary skills and familiarity in handling mechanical equipment exist as part of the general industrial environment, a circumstance leading to high rates of performance of equipment. Such an environment has still to develop in countries with a more recent industrial background, where conditions of work are generally unfavourable and are reflected in inadequate maintenance, high frequency of breakdowns and poor organization of work with, as a result, excessive loss of operating time and low rate of performance."[15]

Mention should be made of the possible impact of external economies or diseconomies on equipment requirements. To produce a given output, a number of ancillary supplies and facilities are required which may be either provided by the firm itself or obtained from the outside. Thus, a large firm may find it economical to produce its own electricity rather than to rely upon locally available power, the regular supply of which may not be assured; in this case the equipment requirements would include power generating machinery which is not part of the investment cost in the case of the firm relying on outside power. The same applies to maintenance or repair facilities in individual plants, particularly machine tools and related equipment. It is to be expected that the data for the United States reflect the well organized markets which exist for these services, there is little need for individual firms to purchase this type of equipment in this country. For under developed countries there are many areas where firms must make provision for producing these services themselves. In both cases the equipment requirements will be above those covered in the estimates, which are limited to directly productive equipment.

It should also be kept in mind that some of the so-called excess capacity which appears to exist in industries in under developed countries reflects the conditions of dynamic growth in these countries. Under conditions of growing demand, a strong case can be made for selecting a scale of operations for a given investment in excess of existing market demand.[16] Consequently, in the early stages of operation of the plant, the rate of output will be consistently below capacity; here again the installed equipment will exceed the theoretical equipment requirements corresponding to the actual increase in output.

Finally, it is necessary to take into account the effects of the level of aggregation of the data used in this project. Within the thirteen principal groupings of industry used in this study, there may be considerable variations in equipment requirements depending on the component elements of these groupings. Since the product mix in the respective groupings may differ from that in the United States, they would affect the aggregate ratios.

RECENT TRENDS IN EQUIPMENT SUPPLY IN RELATION TO THE CALCULATED REQUIREMENTS

In order to test the data on equipment requirements based on practices in the United States, these relationships shall be applied to current developments in the supply of equipment and the growth in industrial pro-

[13] See in this connexion the article, "Use of Welding in Machine Building", by Evgeny P. Unkov, in *Industrialization and Productivity Bulletin*, No. 3.

[14] It may be of some interest to point out that the United Nations Centre for Industrial Development is currently engaged, under its programme of work on industrialization, in research on the influence of size on investment cost in under developed countries. See, for example, the *Studies in Economics of Industry*, No. 1 (Sales No. 63.II.B.3) with reference to the cement industry and nitrogenous fertilizers based on natural gas. See also the article, "Problems of Size of Plant in Industry in Under developed Countries", in *Industrialization and Productivity Bulletin* No. 2; this article is a case study of two specific industries, nitrogenous fertilizers and glass bottles.

[15] From *Industrialization and Productivity Bulletin* No. 1, page 48.

[16] The argument in favour of selecting an initial scale of operation in excess of current demand relies on the well known fact that there are considerable economies in a larger scale of operations. While higher cost conditions might prevail in the early stages of operation, because of under utilization of capacity, with the growth in demand which may be expected in expanding economies, the increase in operations up to full installed capacity results in gradually declining costs. In the longer run, this is preferable to the alternative of meeting the growing demand over time through additional smaller capacity installations, which would result in freezing the cost structure of the industry as a whole at an uneconomic high level. For a more detailed discussion of this problem, see the study, "Problems of Size of Plant in Industry in Under developed Countries", op. cit.

duction in the newly developing countries. It is proposed to analyse the increase in industrial production by main sectors in these countries from 1953 to 1958, and the parallel increase in actual supply of equipment, which includes both imports and domestic production.[17] The latter will then be compared with the hypothetical level of requirements needed to achieve the increase in output under the equipment output assumptions derived above.

In this comparison, a number of statistical and conceptual difficulties must be kept in mind. Firstly, while it is possible to define certain specific equipment requirements for given industries, it is not possible to identify with precision the supply of all equipment actually used in industry. Certain pieces of equipment are multi-purpose and are used not only in manufacturing but in other major sectors of the economy. For example, electric motors may be used in construction and mining, as well as in manufacturing; moreover, in the estimate of equipment requirements, account is taken of internal transport equipment in the plant, while clearly the bulk of transport equipment being used is in activities outside manufacturing.

In order to avoid some of these difficulties, the estimate of equipment requirements has been broken down into two parts. The first includes items of equipment which are either primarily or specifically destined for use in manufacturing industry, the second includes items which are used in other sectors of the economy, and for which manufacturing is not the primary consumer.[18] The latter group thus includes electrical and transport equipment mentioned in the previous paragraph. In the comparisons which are undertaken below, the discussion will centre upon the former component. In the discussion of the implications of the projections of equipment requirements which is found in section II, it will also be necessary to take into account this somewhat arbitrary break down.

Secondly, even in cases where equipment is specifically destined for manufacturing, trade statistics for the period under review make it extremely difficult to isolate this component. A large proportion of these items is classified in the category of machines for special industries (SITC 718), which also includes machinery for mining and construction, and in machinery and appliances, non-electrical, n.e.s. (SITC 719), which, among others, includes machine parts and accessories. Finally, account must be taken of equipment required for replacement through depreciation of the existing stock. This estimate is at best a very rough approximation, due to the well known variations in the life span of equipment and the arbitrary dividing line between replacement and new equipment.

It is estimated that in the under-developed countries value added in all manufacturing (the measure of output used throughout this study) rose from $74 billion to $85.6 billion, or by $11.6 billion (in 1953 prices) between 1953 and 1958. Imports of manufacturing equipment for the five-year period, 1953-1957,[19] roughly estimated in view of the difficulties mentioned above, amounted to $11.7 billion; in addition, domestic production of these items in the same five-year period appears to have amounted to between $0.8 and $1.0 billion (all in 1953 prices).[20]

It may be estimated that investment in new manufacturing equipment required for the increase in output mentioned above would amount to $5.7 billion, based on the marginal equipment output ratios for the individual sectors which are described in the first part of this section. As to replacement requirements, these are estimated by examining the data on output itself. Given an output of $24.5 billion in 1953, and applying the same equipment ratios, it is estimated that the required stock of machinery is $111.0 billion. Assuming an economic life of fifteen years for equipment, over the five-year period, it will be necessary to replace one-third of the 1953 capital stock, amounting to some $37 billion; to this amount should be added a small allowance for depreciation of the increment to the capital stock itself during the period under review, some $0.5 to $0.7 billion.

Thus, the calculated equipment requirements for replacement and new investment amount to $9.4 to $9.6 billion while the actual supply of manufacturing equipment amounted to some $12.7 billion. It is likely, for the reasons mentioned above, that the data on imports overstate the amount of equipment for industry in the sense defined, but this would only account for a small part of the difference between calculated requirements and actual supply. The bulk of the discrepancy, which is of the order of 25 per cent, may be reasonably explained by the cumulative effect of the various factors enumerated above. It might be useful to explore further the distribution of the discrepancies between the calculated requirements and actual supply not only on an aggregate level but also by individual sectors. This would involve a number of statistical problems of reconciliation between the categories used respectively in the foreign trade statistics and the national census data.[21]

[17] An attempt is made to take into account domestic production of equipment in the larger and more advanced countries, such as Argentina, Brazil, India and Yugoslavia.

[18] In the ISIC production statistics, the first group of items, manufacturing equipment proper, appears in group 36 while the others appear in groups 37 and 38. In terms of the Revised Standard International Trade Classification, manufacturing equipment proper corresponds largely to selected groups of SITC 71, namely, SITC 711, Power generating machinery except electric; 715, Metal working machinery; 717, Textile and leather machinery; 718, Machines for special industries; parts of 719, Machinery and appliances, non-electrical, n.e.s.

[19] Imports are lagged by one year in relation to output.

[20] Provisional estimates.

[21] Follow-up research of this type will be undertaken in the requirements of the less developed countries for engineering products and the world supply of such products. See footnote 4.

II. PROJECTIONS OF INDUSTRIAL OUTPUT AND EQUIPMENT REQUIREMENTS

PROJECTIONS OF OUTPUT

As mentioned above, the projections of output in manufacturing industries in the under-developed countries are based upon a parallel study dealing with the growth and structure of industry. The latter study is essentially an econometric analysis of the principal factors determining the levels of output and rate of growth in different branches of industry.[22] The analysis is based upon a series of regression analyses of the 1953-1958 data for some fifty sample countries, both developed and under-developed.

The study assumed that certain key aggregative economic variables, including the level of income and the size of the country, are determining factors in the rate and structure of industrial growth; the study has produced, in the first instance, a simple projection model in which the level and the composition of industrial output are related to two variables: per capita income and population. This simple model has then been modified so as to incorporate in it the effects of other pertinent variables.

The projection of the two independent variables of the simple model has been carried out for the under-developed regions of the world[23] within the following general framework. The period 1958-1975 was divided into three successive sub-periods: 1958 to 1965, 1965 to 1970 and 1970 to 1975, each sub-period being considered as a unit of time or a stage of development more or less individually distinguishable in the long run process of growth. In principle, more optimistic prospects of development are anticipated for the later periods. The prospect for the first seven-year period, 1958-1965, incorporates the actual observations for 1958-1960, but primary reference has been made to intentional data such as the target rates in governments' development plans or particular projection data supplied by various commissions and agencies whenever such data are available. For a number of countries and territories for which the available economic data are poor and fragmentary, the projections are admittedly tentative, though they are based on as much factual evidence as could be collected from experts' reports and opinions, including technical assistance reports.[24] On the whole (and especially for the later periods), the basic assumptions adopted for the income projection involve rather high rates of growth in accordance with the United Nations proposal for the new "Development Decade". The proposal calls for such highly intensified efforts on the part of newly developing countries and the assisting international organizations that most of these countries should reach or pass the so-called "take-off" stage of growth by the end of the Decade; this has been interpreted as the possibility of assigning *at least* 5 per cent annual rates of growth in national income for the period 1970-1975, if not the prior period, in most of the countries considered. The projections of national income, as well as other variables such as population and "relative degree of industrialization" have been carried out primarily on a country basis.

For the total of "under-developed" countries and territories, the projected growth in per capita national income by 1970 and 1975 has turned out to be 40 and 69 per cent, respectively, or 2.9 and 3.1 per cent, respectively, in terms of annual average rates over the twelve and seventeen years. The annual average rate for the last five-year period is 3.7 per cent, which is appreciably higher than the 1958-1970 annual average.

As stated earlier, information on factors other than the above-mentioned two variables required a modification of the simple model, which consisted in introducing in the model an additional variable of a derived nature which was designed in such a way as to reflect the country's actual position in relation to the "normal" level (this is, the calculated level "explained" by the two independent variables: per capita income and size) at a given point of time. The statistical evidence suggested that the dispersion around the "normal" line is considerably greater for the lower per capita income countries than for higher income groups; and also that the speed of industrialization relative to a given rate of income growth tends to be higher at the earliest stages of industrialization (varying with the income level and the proportion of industrial output in total output). This additional variable was measured, for each country, in terms of the deviation between the actual and the "normal" level of *total* manufacturing corresponding to given per capita income and population. This deviation, which was labelled "relative degree of industrialization" (D), was then introduced in the set of sectoral equations which determine the sector composition of a given total manufacturing output.

Given the existing pattern in relation to the normal pattern and also the published material on long-term targets and other policy goals of the various countries, a value was assigned for each country for the variable "D"; for some countries, the projection of this variable

[22] *See* foot note 6.

[23] The under-developed regions comprise all of Latin America; Africa excluding South Africa; Middle East; Asia excluding Japan, and the centrally planned economies; plus five under-developed countries of Europe (Greece, Portugal, Spain, Turkey and Yugoslavia). The total number of such countries and territories is 100 (excluding only territories and dependencies with less than 500,000 population), with their population totalling some 1.3 billion (about 45 per cent of the world total) and their income 180 billion in current United States dollars (about 18 per cent of the world total income) in 1958. These figures include estimates for the centrally planned economies.

[24] At this particular stage of projection, the present study has also taken advantage of Professor Rosenstein-Rodan's study, "International Aid for Under-developed Countries", in *Review of Economics and Statistics*, May 1961. However, extensive reference to official planning data and especially to the "Development Decade" prospect for the later periods in the present study has resulted in modifying Professor Rosenstein-Rodan's scale with further optimistic bias.

may have been even more tentative than that of income. Since a rapid growth in national income is normally accompanied by a still faster industrialization, the strong assumptions for income projections have generally to be supported by correspondingly strong assumptions for the future behaviour of this variable. The correspondence between the two projections is not straightforward, however; the evidence from the past data has suggested that countries positioned close to the "normal" (D-1) tend to be more stable in terms of their values of D than countries whose initial positions widely deviate from the normal.

In projecting the value of output in individual sectors, account was also taken of the existing deviations (as at the base year 1958) from the "normal" pattern. In this part of the exercise it was assumed that further industrialization would tend to approach, as time goes on, the normal pattern, the existing deviation thus being regarded as accidental or temporary. This assumption took into account the statistical evidence that lagging sectors appeared to grow more rapidly than those which behaved according to the "normal" pattern. In the long run, it would appear that industrialization efforts are concentrated on providing a more diversified rather than specialized structure of the domestic economy. Thus, the relative speed of growth in the value added for the various sectors depends not only on the projected rates of increase in the three independent variables but on the initial position of the over-all level of industrialization of a country as well.

Appendix tables II and III summarize the results of projections of value added by principal groups of manufacturing industries and also by regional totals.

EQUIPMENT PROJECTIONS AND THEIR IMPLICATIONS

The procedure of projecting the levels and structure of manufacturing industries in the developing countries for the period 1970-1975 has been outlined above. In the following paragraphs, the level of equipment requirements will be discussed, assuming the relationships between manufacturing output and equipment explored earlier. The estimates of equipment requirements are built up in two stages. In the first stage estimates are made of the equipment required to achieve the increase in output between the base period 1958 and the target years, 1970 and 1975. To these are added estimates of replacement requirements which are based on an expected life span of fifteen years. The estimate of this element takes into account replacement of the existing stock of equipment, including the annual increments to the capital stock during the period under review (*see* appendix table VI).

In order to make these figures comparable with the annual output of the industries which produce this equipment, it is necessary to convert them into data approximating annual flows. Under the assumptions mentioned above, equipment requirements for the five-year period 1970-1975 will total some $30 billion. The requirements for the end year 1975 may be calculated at some $10 billion.

It has been argued earlier that there are reasons to believe that the calculated data understate for a variety of reasons the actual requirements. As noted in section I, there are the factors of a generally unfavourable industrial climate in under-developed countries which makes for a lower rate of performance; a scale of operations which is likely to be below the average prevailing in the advanced countries; a certain degree of under utilization of capacity in the earlier stages of operation of newly established industries, and so on. One might argue on the other hand that the replacement requirements, which are not derived as replacement *per se* but in analogy with depreciation allowance, would involve rather an overestimation, especially for the later part of the period considered when the capital stock is increasing rapidly. This bias for overestimation may not be too serious, however, in view of the relatively fast rate of deterioration resulting from poor maintenance in under-developed countries as well as the pressure of technological obsolescence which will be felt more or less continually. In balance, the above estimate of $10 billion could still be considered as understating the actual requirements in developing countries; it might thus be raised by some 20 to 30 per cent to the level of some $12 billion to $13 billion per annum.

In order to evaluate the significance of the figure, it will be recalled that a distinction was drawn earlier between manufacturing equipment proper and total equipment used in industry; this problem was dealt with in section I. Of the less than $10 billion of equipment requirements, it may be expected that manufacturing equipment proper would amount to $8 billion; the remainder would be accounted for by such items as are used in other economic sectors and of which manufacturing is only a marginal consumer.

The problem which will be examined next is the capacity of the under-developed countries to meet their requirements from domestic production. The data on equipment supply presented earlier indicate that in 1958 less than 10 per cent of their requirements were met from domestic production. An indication of the probable growth in domestic output of manufacturing equipment in these countries is provided by the trends in output in the sector of metal goods fabricating industries. As noted on a number of occasions in this study, manufacturing equipment represents only a certain part of the output of this sector; the magnitude of this proportion may be derived from a comparison of some statistical data. Table 2 gives for a few selected countries the proportion of manufacturing equipment proper in the total output for the sector of metal goods fabricating industries.

There is little doubt that manufacturing equipment proper represents one of the most sophisticated groups of products, in terms of skills and basic machinery, which are involved. In 1958 production of manufacturing equipment proper represented for the total of under-developed countries no more than 2 per cent of the output in the metal goods fabricating industries, and even in the more advanced among these countries, such as Brazil

Table 2

OUTPUT OF VARIOUS TYPES OF EQUIPMENT AS A PROPORTION OF THE TOTAL METAL GOODS FABRICATING INDUSTRIES' OUTPUT, SELECTED COUNTRIES, 1958

(Percentages)

Country	Machinery							Transportation equipment (ISIC 384)	Metal goods, excluding machinery and transportation (ISIC 35)	Total metal goods fabricating industries (ISIC 35-38)
	Industrial equipment				Other machinery					
	Non-electrical									
	Manufacturing equipment proper	Other industries	Electrical	Total	Non-electrical[a]	Electrical[b]	Total machinery (ISIC 36, 37)			
Brazil	6.1	1.8	3.7	11.6	2.3	27.9	41.8	38.3	19.9	100.0
Yugoslavia	7.6	1.3	6.4	15.3	2.2	16.4	33.9	14.9	51.2	100.0
Canada	8.8		5.6	14.4	6.2	17.7	38.3	47.7	14.0	100.0
United Kingdom	7.5	3.4	5.1	16.0	10.3	19.3	45.6	38.6	15.8	100.0
Germany (Federal Republic)	13.4	5.1	5.0	23.5	10.6	18.8	52.9	23.1	24.0	100.0
United States	15.5	4.3	5.9	25.7	6.3	16.0	48.0	32.2	19.8	100.0
Japan[c]	17.4	1.7	9.9	29.0	6.2	19.4	54.6	30.9	14.5	100.0

Source: Compiled at the Centre for Industrial Development, Research and Evaluation Division, from national industrial censuses.

[a] Other non-electrical machinery covers machinery used by agriculture, offices and households.

[b] Includes communication apparatus and equipment.

[c] 1956.

and Yugoslavia, this proportion is at the present time considerably less than 10 per cent. The bulk of output in the remaining categories is accounted for by durable consumer goods, such as electric fans, bulbs, radios and other appliances, bicycles and, in the more advanced countries, automobile assembly; this category also includes the output of repair and maintenance shops, which is particularly important in an area where spare parts for equipment are frequently fabricated domestically. While it may be expected that there will be considerable progress in the output of industrial equipment, it does not appear likely that the proportion of manufacturing equipment proper in total metal-fabricated products would rise for the total of under-developed countries to more than 4 per cent by 1975.

The projection of total output in the metal goods fabricating industries for 1975 gives a figure of $34 billion in terms of manufacturing value added. The corresponding output under the category of manufacturing equipment proper under the assumption just explored would amount to some $1.3 billion to $1.4 billion, in value added. It is necessary to convert these data into equivalent gross or sales value, in which the equipment requirements are measured. As is well known, the value added in these particular industries represents a very high share of gross value of output. In countries such as the United Kingdom and the Federal Republic of Germany, the census data indicate that this share amounts to 55 per cent. Applying this conversion factor to the value added data, it would appear that the gross value of output of such equipment would amount to $2.5 billion.

An estimate of domestic production in 1975 can also be obtained by extrapolating the current level of output in this category, taking into account the expected increase in production in the metal-fabricating industries. The gross value of manufacturing equipment proper produced in all under-developed countries in 1958 is estimated at some $200 million. Production of metal products in 1975 is expected to be 5.7 times higher than production in 1958. The above estimate of output of industrial equipment, $2.5 billion, would indicate a much larger rate of increase in production of industrial equipment. In view of the emphasis which is being given in a number of countries to production of capital goods required for industry, it does seem likely that the increase in output of these items would be higher than for the other metal-fabricated items. Consequently, the estimate of $2.5 billion of manufacturing equipment proper in 1975 appears to be reasonable, although somewhat optimistic; this would represent nearly one-third of total requirements.

It would therefore appear that about $7.5 billion of industrial equipment would have to be imported from the developed countries which are now the primary suppliers of equipment.[25] It might be useful to examine

[25] According to these estimates the under-developed countries' import requirements of manufacturing equipment proper (most of SITC 71) will rise from the $3 billion total in 1958 to $7.5 billion in 1975. The $7.5 billion imports of manufacturing equipment will satisfy two-thirds of the under-developed countries' total requirements in 1975, with the other third produced domestically. In a note submitted by the Government of Czechoslovakia to the Economic Commission for Europe (Eng./Conf.2/Add.3), it was estimated that the under-developed countries' total import requirements of all engineering goods (covering the entire SITC division 7), would rise from $8 billion in 1960 to $18 billion in 1970, and that by 1970, the under-developed countries will produce from 60 to 65 per cent of their requirements of all engineering goods.

It is to be expected that the share of domestic production in

at this point the relationship of these requirements to the existing capacity in those countries. Using the techniques which have been presented earlier for projecting output in the under-developed countries, it is possible to project the level of output in the metal goods fabricating industries of the developed countries in 1975; these projections indicate that total output of metal products would rise by 160 per cent under this assumption.

Assuming that the share of industrial equipment in total output of metal goods fabricating industries in the developed countries (as shown in table 2) will not change, an increase in exports at the same rate as the output of metal goods fabricating industries would imply a level of export availability in the developed countries of nearly $8 billion in 1975. It then appears that the share of exports to under-developed countries in the output of industrial equipment in the developed countries will remain close to the one observed in the late 1950's. One must also take into account the imports from the centrally planned economies.[26]

COMPOSITION OF REQUIREMENTS

The aim of this part of the analysis is to provide some insight into the structure of equipment requirements, particularly from the point of view of the supplying industries.

As noted in the introduction, the classification of equipment used in this study has followed that used in a study of the United States economy. The emphasis of that study was on industrial mobilization, and the classification was designed with that purpose in mind. Nevertheless, as can be seen from the list of items which appear in appendix table IV, this classification is sufficiently broad to serve a number of other purposes.

By far the principal part of equipment requirements for individual industrial sectors, and therefore for manufacturing in total, is made up of special-purpose machinery. For example, in the category of metal products, almost 80 per cent of equipment requirements is composed of machine tools and associated metal-working equipment.[27] For the other sectors, the category entitled "Special industrial machinery" generally covers that part of equipment which can be used only in the selected industry groupings; for such industries as textiles, pulp and paper, printing, leather and clothing, more than 80 per cent of the equipment requirements would fall into these categories.

The remaining items in the list in appendix table IV are basically general-purpose equipment which are used across the board in manufacturing and, to some extent, in other sectors of the economy, such as construction and mining. Some indication of the importance of the individual categories of equipment is given in the distribution of total requirements reflecting the particular pattern of growth of manufacturing industries, as projected in this study.

The distinction which was made in the earlier section between manufacturing equipment proper and that for which manufacturing is only a marginal consumer is reflected in the second half of the table. The items which are used primarily outside of manufacturing consist of some non-electrical machinery, such as tractors, machinery for construction including mining, and commercial machinery. Accordingly, the equipment requirements by manufacturing industries in total non-electrical machinery amount to 87 per cent. The rest is made up of electrical industrial machinery (8.2 per cent) and transportation equipment (4.8 per cent).[28]

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total supply of all engineering goods (SITC 7) would be higher than the share of domestic production in the supply of the very specialized group comprising manufacturing equipment proper, which has a limited market.

[26] This is somewhat different from what can be expected in the case of electrical and transportation equipment. For electrical equipment, which constitutes less than 10 per cent of total equipment requirements by manufacturing industries, the rising share of domestic production in under-developed countries is illustrated by the case of Yugoslavia, discussed below. The trend towards self-sufficiency in previously non-producing countries was also noted for electric motors in a study by the United States Department of Commerce, "World Survey of Electric Motors, 1955-1959". For transportation equipment, which covers less than 5 per cent of the manufacturing industries' equipment requirements, a considerable amount of import substitution can well be expected, particularly with assembling of motor vehicles.

[27] *See* appendix table IV.

[28] The high proportion of transport equipment in the food and wood industries reflects the particular characteristics of these industries in the United States, and, for some industries, of the nature of the United States data. For the food processing industries, an important element is the transport material needed to bring the fresh foodstuffs to the processing plants. For the wood industries, because of difficulties in separating the relevant information, the United States data include logging in the mills' activities; this logging operation requires considerable transport equipment.

III. CONCLUSIONS

THE MAIN PURPOSE of this paper has been to attempt to shed some light on the magnitude of the equipment requirements for industrial growth in the under-developed countries. The data have been analysed in terms of (i) the projected capacity of the under-developed countries to meet their own requirements and (ii) the impact of export demand on the engineering industries in the more advanced countries. It is expected that this exploratory attempt will be amplified in a number of directions in order to make the results of practical use for both the user and producer countries.

The data of this study are subject, as has been mentioned on several occasions, to a certain number of limitations, both statistical and conceptual; however,

while the resulting data are provisional and tentative, certain trends appear to emerge from the analysis. In a parallel study undertaken by the ECE secretariat,[29] it was noted that there is some evidence of a decline in the importance of industrial equipment in the output of the engineering industries in Europe. The data presented in this particular study suggest that the future demand from under-developed countries may act as an offset to this tendency.

The data also confirm the presumption that in spite of the growth of metal-fabricating industries in the under-developed countries, a considerable part of their equipment requirements will have to be met from the output of the advanced countries. It should be kept in mind that even in certain of the rapidly-developing countries, such as Yugoslavia, there is a certain tendency for specialization within this particular field. It would appear, for example, that at the present time Yugoslavia is a net exporter of electrical generating and transmitting equipment but continues to be a net importer of most of its manufacturing equipment; and that, moreover, in the next decade such a tendency is likely to continue because of, among other things, the limited domestic market for certain industrial equipment whose production is particularly subject to increasing returns to scale. For the under-developed countries in general it appears that most of their development programmes take such a contingency into account so that emphasis is being given to production of those metal-fabricated products which have adequate internal markets in relation to the economic scale of production. As indicated earlier, this relates particularly to consumer durables and general-purpose electrical industrial machinery for which productive facilities are being expanded at a rapid rate.

As regards the potential markets in the newly developing countries for the output of the advanced countries, these raise not only problems of volume but also of the types of equipment which are most suitable for the former. There is, necessarily, the question of adaptation of equipment and processes to the particular conditions of the developing countries. It was noted above that these countries, in view of their relative supply of resources, should theoretically tend to choose capital-saving techniques within the range of technological flexibility of the industrial operations.[30] It was noted, at the same time, that this aspect is frequently being neglected and that the technology used in industry generally follows in an indiscriminate way the patterns which are more appropriate to the conditions of the developed countries where the main body of skills and production capacity resides and which, moreover, account for the major part of this demand in the category of output. It would therefore appear that a conscious effort is needed on the part of the equipment producing industry to redesign equipment and processes for the particular conditions of the under-developed countries. Both for the equipment exporting countries and the developing countries which are in the process of building up their own equipment industries, expenditure on research and development in this direction should yield significant returns.

[29] United Nations, *Production and Export of Mechanical and Electrical Engineering Goods* (Sales No.: 63.II.E/Mim.12).

[30] *See* page 11.

Statistical Appendix

Table 1

NATIONAL INCOME, 1958, AND PROJECTIONS TO 1970 AND 1975
(1953 United States dollars)

Geographical region[a]	1958	1970	1975	1958	1970	1975
	Total national income (billions of dollars)			Per capita income (dollars)		
Asia	51.6	92.7	124.2	70.2	98.7	119.4
Africa	17.5	26.9	35.1	91.5	115.3	138.4
Middle East	10.4	17.8	24.6	143.1	184.0	225.8
Latin America	53.1	99.8	132.7	276.2	387.3	456.2
Europe (5 countries)	26.5	48.0	62.5	290.8	443.2	535.2
TOTAL, under-developed countries	159.1	285.2	379.1	124.1	174.4	209.4
			Indices, 1958 = 100			
Asia	100	180	241	100	141	170
Africa	100	154	201	100	126	151
Middle East	100	171	237	100	129	158
Latin America	100	188	250	100	140	165
Europe (5 countries)	100	181	236	100	152	184
TOTAL, under-developed countries	100	179	238	100	141	169

Source: Compiled by Research and Evaluation Division of United Nations Centre for Industrial Development in connexion with *A Study of Industrial Growth*, op. cit.

[a] Countries and territories included are:

Asia, excluding Japan and centrally planned economies
Afghanistan, Bhutan, British Borneo, Burma, Cambodia, Ceylon, China (Taiwan), Malaysia, Hong Kong, India, Indonesia, Laos, Nepal, P kistan, Philippines, Portuguese India, Republic of Korea, Republic of Viet-Nam, Ryukyu Islands, Thailand, West Irian.

Africa, excluding South Africa
Algeria, Angola, Basutoland, Burundi, Cameroon (East Cameroon and West Cameroon), Central African Republic, Chad, Congo (Brazzaville), Congo (Leopoldville), Dahomey, Ethiopia, Federation of Rhodesia and Nyasaland, Gabon, Ghana, Guinea, Ivory Coast, Kenya, Liberia, Libya, Madagascar, Mali, Mauritania, Mauritius, Morocco, Mozambique, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South West Africa, Sudan, Tanganyika, Togo, Tunisia, Uganda, Upper Volta.

Middle East
Aden, Bahrain, Cyprus, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Saudi Arabia, Syria, United Arab Republic, Yemen.

Latin America
Argentina, Bolivia, Brazil, British Guiana, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Federation of The West Indies, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, Venezuela.

Europe
Greece, Portugal, Spain, Turkey, Yugoslavia.

Table II

PROJECTIONS OF TOTAL VALUE ADDED BY MANUFACTURING INDUSTRIES, 1958 TO 1970 AND 1975

Geographical region[a]	*1958*	*1970*	*1975*
	(billions of 1953 United States dollars)		
Africa	1.8	4.2	6.8
Asia	8.0	21.9	35.4
Middle East	1.3	3.5	5.6
Latin America	16.1	39.4	57.2
Europe (5 countries)	8.4	18.3	27.1
TOTAL, under-developed countries	35.6	87.3	132.1
	Indices, 1958 = 100		
Africa	100	234	379
Asia	100	272	441
Middle East	100	277	434
Latin America	100	248	360
Europe (5 countries)	100	218	323
TOTAL, under-developed countries	100	245	371

Source: Compiled by Research and Evaluation Division of United Nations Centre for Industrial Development in connexion with *A Study of Industrial Growth*, op. cit.

[a] *See* foot-note *a* to table 1.

Table III

PROJECTIONS OF VALUE ADDED BY MANUFACTURING SECTORS, 1970 AND 1975
(Millions of 1953 United States dollars; Indices,[a] 1958 = 100)

Geographical region and year	*Food, beverages and tobacco (ISIC 20-22)*	*Textiles (ISIC 23)*	*Clothing (ISIC 24)*	*Wood products (ISIC 25-26)*	*Paper and paper products (ISIC 27)*	*Printing and publishing (ISIC 28)*
Africa						
1970	1,450 (246)	395 (263)	270 (261)	185 (305)	65 (431)	130 (242)
1975	2,150 (364)	655 (441)	425 (415)	320 (526)	130 (885)	215 (403)
Asia						
1970	4,125 (223)	4,805 (208)	775 (315)	765 (260)	340 (236)	405 (390)
1975	5,860 (317)	7,035 (305)	1,235 (502)	1,195 (406)	560 (387)	670 (643)
Middle East						
1970	910 (303)	600 (168)	205 (321)	165 (342)	75 (365)	100 (325)
1975	1,340 (445)	805 (227)	320 (505)	270 (559)	135 (644)	175 (565)
Latin America						
1970	6,990 (173)	3,785 (226)	1,730 (238)	1,685 (258)	1,135 (337)	1,305 (249)
1975	8,660 (214)	5,300 (317)	2,420 (333)	2,425 (372)	1,750 (519)	1,915 (365)
Europe (5 countries)						
1970	2,430 (191)	2,225 (157)	920 (196)	1,150 (171)	575 (294)	560 (289)
1975	3,330 (262)	2,875 (203)	1,285 (274)	1,545 (230)	940 (481)	885 (458)
TOTAL, under-developed countries						
1970	15,905 (197)	11,810 (200)	3,900 (243)	3,950 (229)	2,190 (307)	2,500 (276)
1975	21,340 (265)	16,670 (282)	5,685 (354)	5,755 (333)	3,515 (493)	3,860 (426)

Geographical region and year	*Leather products (ISIC 29)*	*Rubber products (ISIC 30)*	*Chemicals and petroleum products (ISIC 31-32)*	*Non-metallic mineral products (ISIC 33)*	*Basic metals (ISIC 34)*	*Metal products (ISIC 35-38)*	*Other manufactures (ISIC 39)*
Africa							
1970	90 (322)	35 (520)	310 (288)	330 (185)	235 (156)	660 (228)	60 (203)
1975	105 (384)	60 (924)	530 (494)	515 (288)	370 (242)	1,220 (423)	130 (425)
Asia							
1970	355 (150)	435 (156)	2,725 (464)	1,150 (286)	1,950 (416)	3,665 (363)	385 (365)
1975	440 (188)	585 (211)	4,865 (828)	1,760 (438)	3,815 (815)	6,710 (664)	685 (651)

Table III (continued)

Geographical region and year	*Leather products (ISIC 29)*	*Rubber products (ISIC 30)*	*Chemicals and petroleum products (ISIC 31-32)*	*Non-metallic mineral products (ISIC 33)*	*Basic metals (ISIC 34)*	*Metal products (ISIC 35-38)*	*Other manufactures (ISIC 39)*
Middle East							
1970	45 (365)	50 (210)	345 (254)	235 (293)	140 (415)	610 (402)	60 (292)
1975	65 (545)	75 (316)	545 (402)	360 (442)	260 (786)	1,095 (724)	105 (493)
Latin America							
1970	300 (191)	520 (208)	5,180 (199)	1,845 (224)	3,500 (396)	10,605 (359)	850 (348)
1975	375 (237)	755 (303)	7,330 (282)	2,465 (299)	5,650 (638)	16,825 (569)	1,360 (558)
Europe (5 countries)							
1970	190 (139)	275 (179)	1,890 (228)	980 (174)	1,770 (213)	4,960 (318)	360 (378)
1975	230 (167)	385 (252)	2,830 (342)	1,305 (231)	2,695 (324)	8,210 (526)	610 (638)
Total, under-developed countries							
1970	980 (172)	1,315 (185)	10,450 (245)	4,540 (221)	7,595 (314)	20,500 (343)	1,715 (346)
1975	1,215 (213)	1,860 (261)	16,100 (378)	6,405 (312)	12,790 (530)	34,060 (571)	2,890 (583)

Source: Compiled by Research and Evaluation Division of United Nations Centre for Industrial Development in connexion with *A Study of Industrial Growth*, op. cit.

Note: Figures do not necessarily add to totals because of rounding.

[a] Figures in parentheses are index numbers.

Table IV

1975 ESTIMATED PERCENTAGE DISTRIBUTION OF TOTAL (NEW AND REPLACEMENT) EQUIPMENT REQUIREMENTS OF MANUFACTURING INDUSTRIES IN UNDER-DEVELOPED COUNTRIES

Principal categories of equipment	*Total manufacturing[a] (ISIC 2-3)*	*Food, beverages and tobacco (ISIC 20-22)*	*Textiles (ISIC 23)*	*Clothing (ISIC 24)*
I. Non-electrical machinery				
Engines and turbines	0.7	1.2	—	0.1
Machine tools, metal-working machinery	27.4	—	1.0	0.05
Cutting tools, jigs and fixtures	1.7	—	—	—
Special industrial machinery	34.5	46.2	91.7	88.5
Pumps and compressors	2.9	0.6	0.1	—
Elevators and conveyors	6.8	10.6	0.5	0.05
Blowers and fans	1.8	2.4	0.1	0.05
Power transmission	0.5	—	0.3	0.05
Refrigerator equipment	1.8	9.0	0.7	0.1
Industrial machinery n.e.s	4.8	9.6	0.5	0.1
TOTAL, manufacturing equipment proper	82.9	79.6	94.9	89.0
Tractors	1.0	—	0.3	0.05
Construction machinery	1.7	—	—	—
Commercial machinery	1.4	3.2	0.7	2.7
TOTAL, non-electrical machinery	87.0	82.8	95.9	91.75
II. Electrical industrial machinery				
Motors and generators	3.3	2.6	0.7	0.1
Transformers	0.8	—	0.4	0.05
Electrical control apparatus	2.2	—	0.1	—
Electrical welding	1.4	—	—	—
Electrical appliances	0.5	0.1	—	7.1
TOTAL, electrical machinery	8.2	2.7	1.2	7.25
III. Transportation equipment				
Motor vehicles	3.0	12.5	0.9	0.7
Locomotives and railroads	1.8	2.0	2.0	0.3
IV. Total	100.0	100.0	100.0	100.0

Table IV (continued)

Principal categories of equipment	*Wood products (ISIC 25-26)*	*Paper and paper products (ISIC 27)*	*Printing and publishing (ISIC 28)*	*Leather products (ISIC 29)*
I. Non-electrical machinery				
Engines and turbines	0.9	0.3	—	2.2
Machine tools, metal-working machinery	18.9	0.5	—	—
Cutting tools, jigs and fixtures	1.7	—	—	—
Special industrial machinery	28.8	72.6	90.7	92.8
Pumps and compressors	2.5	1.5	—	—
Elevators and conveyors	8.3	3.7	5.0	—
Blowers and fans	0.8	0.9	—	—
Power transmission	0.1	4.0	0.1	—
Refrigerator equipment	—	0.3	—	—
Industrial machinery n.e.s	4.3	1.0	—	—
TOTAL, manufacturing equipment proper	66.3	84.8	95.8	95.0
Tractors	5.2	3.0	—	—
Construction machinery	2.9	0.5	—	—
Commercial machinery	1.0	1.6	3.0	2.4
TOTAL, non-electrical machinery	75.4	89.9	98.8	97.4
II. Electrical industrial machinery				
Motors and generators	0.5	3.3	0.2	0.9
Transformers	0.2	2.2	—	—
Electrical control apparatus	1.3	2.8	0.1	—
Electrical welding	0.5	0.5	—	—
Electrical appliances	0.3	0.1	—	—
TOTAL, electrical machinery	2.8	8.9	0.3	0.9
III. Transportation equipment				
Motor vehicles	11.2	1.2	0.9	1.7
Locomotives and railroads	10.6	—	—	—
IV. Total	100.0	100.0	100.0	100.0

Principal categories of equipment	*Rubber products (ISIC 30)*	*Chemical and petroleum (ISIC 31-32)*	*Non-metallic minerals (ISIC 33)*	*Basic metals (ISIC 34)*	*Metal products (ISIC 35-38)*
I. Non-electrical machinery					
Engines and turbines	—	2.5	—	0.8	—
Machine tools, metal-working machinery	—	1.4	2.9	41.2	72.6
Cutting tools, jigs and fixtures	—	—	—	0.1	6.4
Special industrial machinery	—	47.8	48.3	5.5	1.0
Pumps and compressors	27.9	11.6	1.7	1.6	1.3
Elevators and conveyors	17.5	5.3	11.4	15.1	2.5
Blowers and fans	8.0	3.5	1.3	2.7	1.1
Power transmission	20.2	0.2	0.6	0.2	—
Refrigerator equipment	—	4.0	0.2	0.2	—
Industrial machinery n.e.s	22.4	7.8	3.1	3.1	5.0
TOTAL, manufacturing equipment proper	96.0	84.1	69.5	70.5	89.9
Tractors	—	0.4	1.0	0.4	1.6
Construction machinery	—	1.2	12.0	4.0	0.5
Commercial machinery	1.4	1.2	1.0	0.5	1.4
TOTAL, non-electrical machinery	97.4	86.9	83.5	75.4	93.4
II. Electrical industrial machinery					
Motors and generators	—	4.6	3.0	10.2	0.3
Transformers	—	1.4	0.6	1.4	0.9
Electrical control apparatus	—	2.7	7.1	5.1	1.6
Electrical welding	—	1.4	0.1	3.4	2.1
Electrical appliances	—	0.7	—	--	1.0
TOTAL, electrical machinery	—	10.8	10.8	20.1	5.9

Table IV (continued)

Principal categories of equipment	*Rubber products* (ISIC 30)	*Chemical and petroleum* (ISIC 31-32)	*Non-metallic minerals* (ISIC 36)	*Basic metals* (ISIC 37)	*Metal products* (ISIC 38)
III. Transportation equipment					
Motor vehicles	2.6	1.1	5.6	[illegible]	[illegible]
Locomotives and railroads	[illegible]	0.9	0.1	1.1	
IV. Total	100.0	100.0	100.0	[illegible]	[illegible]

Source: Equipment/output ratios for industry sectors, compiled from unpublished material supplied by Harvard Economic Research Project, applied to 1975 projections (medium assumptions of output by industry sectors).

[a] Total manufacturing, excluding miscellaneous industries (ISIC 39), is the weighted average of ISIC sectors 20-38.

Table V

WORLD EXPORTS OF MACHINERY AND TRANSPORTATION EQUIPMENT BY REVISED SITC DIVISIONS AND SELECTED SUB GROUPS TO UNDER DEVELOPED AND DEVELOPED AREAS, IN CURRENT PRICES

(Billions of United States dollars)

Exports to	*1953*	*1955*	*1960*	*1961*	*1962*
Under-developed countries					
SITC 711, 715; 717-719: Manufacturing equipment proper[a]	1.8	2.9	.	3.5	.
SITC 712-714: Other non-electrical machinery	0.4	0.6	.	0.9	.
SITC 71: Total non-electrical machinery	2.2	3.5	4.2	4.4	.
SITC 72: Electrical machinery	1.2	1.6	1.7	1.9	.
SITC 73: Transportation equipment	3.2	3.8	4.3	4.4	.
SITC 7: Machinery and transportation equipment	6.6	8.9	10.2	10.7	.
SITC 0-9: All commodities[b]	23.7	30.7	33.2	34.6	35.6
Developed countries					
SITC 711, 715; 717-719: Manufacturing equipment proper[a]	2.3	3.6	.	6.1	.
SITC 712-714: Other non-electrical machinery	0.6	1.0	.	1.6	.
SITC 71: Total non-electrical machinery	2.9	4.6	6.4	7.7	.
SITC 72: Electrical machinery	0.9	1.4	2.3	2.9	.
SITC 73: Transportation equipment	1.8	3.5	4.6	4.5	.
SITC 7: Machinery and transportation equipment	5.6	9.5	13.3	15.1	.
SITC 0-9: All commodities[b]	52.2	70.6	76.0	89.2	96.0
World					
SITC 711, 715; 717-719: Manufacturing equipment proper[a]	4.1	6.5	.	9.6	.
SITC 712-714: Other non-electrical machinery	1.0	1.6	.	2.5	.
SITC 71: Total non-electrical machinery	5.1	8.1	10.6	12.1	.
SITC 72: Electrical machinery	2.1	3.0	4.0	4.8	.
SITC 73: Transportation equipment	5.0	7.3	8.9	8.9	.
SITC 7: Machinery and transportation equipment	12.2	18.4	23.5	25.8	.
SITC 0-9: All commodities[b]	75.9	101.3	118.8	123.8	131.6

Source: Compiled from United Nations, ***Commodity Trade Statistics***, and from Organisation for Economic Co-operation and Development, ***Statistical Bulletins, Foreign Trade***. One dot (.) indicates that data were not compiled.

Note: World exports of machinery and transportation equipment are shipments from the countries of western Europe (Common Market and EFTA), Canada, United States, Japan, Australia, New Zealand and South Africa.

Exports to the centrally planned economies are included in the exports to the developed countries.

Under-developed countries are as defined in table I of this appendix.

[a] Manufacturing equipment proper includes a few items that could not be segregated, such as construction and mining machinery (SITC 718.4), mineral crushing and sorting machinery (SITC 718.5) and some other, non-manufacturing machinery and parts included in machinery and appliances, non-electrical, n.e.s. (SITC 719).

[b] World exports of all commodities (SITC 0-9) are the imports from all countries excluding the centrally planned economies.

Table 11

ESTIMATED INVESTMENT REQUIREMENTS IN INDUSTRIAL EQUIPMENT FOR MANUFACTURING INDUSTRIES IN THE LESS DEVELOPED COUNTRIES DURING THE PERIODS 1958 to 1970 AND 1970 to 1975[a]

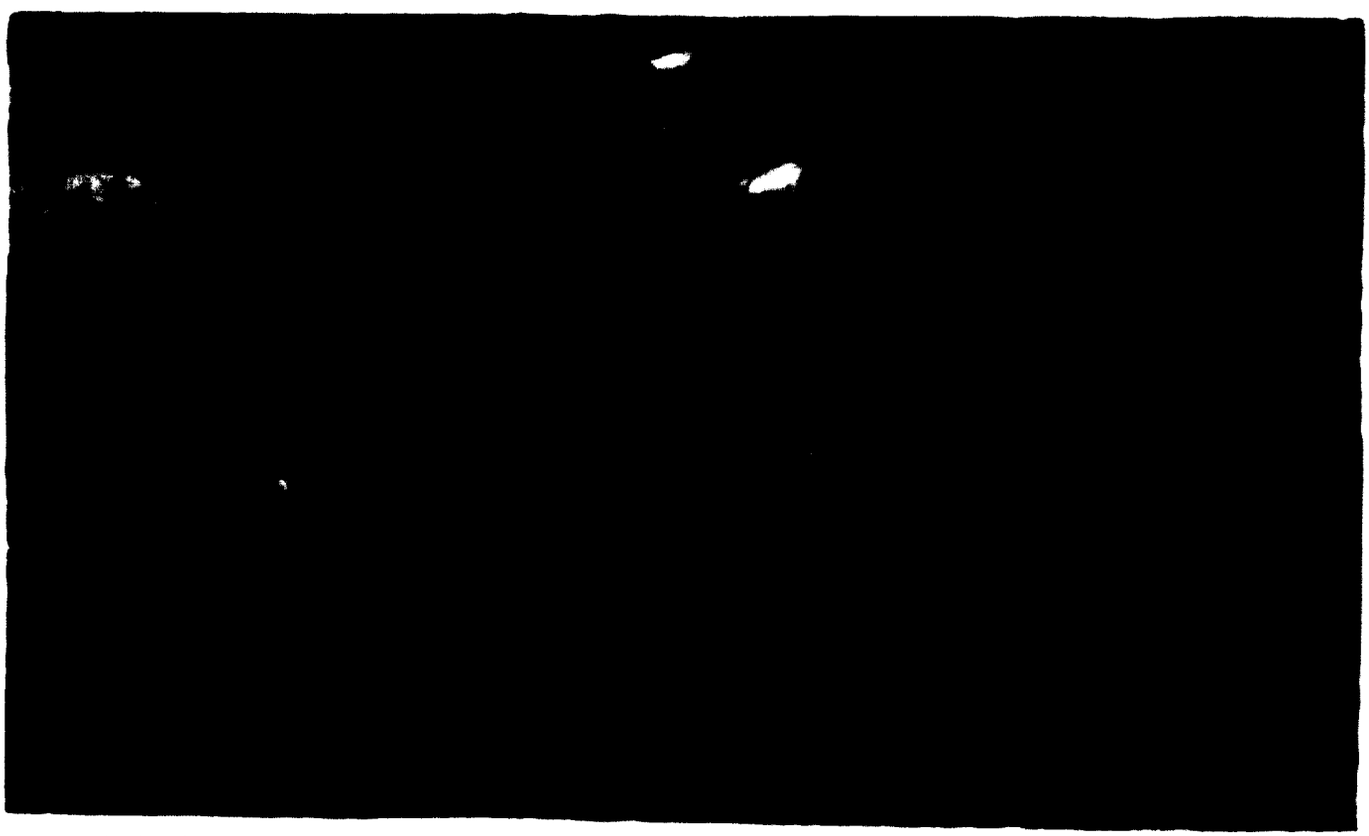
(Billions of 1953 United States dollars)

Geographical area and period	Increments to capacity	Replacements	Total requirements
Africa			
1958 to 1970	1.2	1.1	2.3
1970 to 1975	1.3	1.0	2.3
Asia			
1958 to 1970	7.4	5.0	12.4
1970 to 1975	7.5	5.2	12.8
Middle East			
1958 to 1970	1.1	0.8	1.9
1970 to 1975	1.0	0.8	1.8
Latin America			
1958 to 1970	12.6	11.0	23.7
1970 to 1975	9.7	8.7	18.4
Europe (5 countries)			
1958 to 1970	5.2	5.4	10.7
1970 to 1975	4.8	4.1	8.8
Total, under-developed countries			
1958 to 1970	27.7	23.3	50.9
1970 to 1975	24.3	19.8	44.1

Source: Data estimated by Research and Evaluation Division of United Nations Centre for Industrial Development

Note: Figures do not necessarily add to total indicated because of rounding.

[a] Requirements have not been adjusted to manufacturing equipment proper and possible under-utilization of equipment.



Some of the hundreds of manual workers engaged in earth-cutting and earth-moving operations on a project for the development of the port of Calcutta, India on the Hooghly River

Choice of Capital Intensity in Industrial Planning

THE FOLLOWING ARTICLE is a part of a series of studies on capital intensity published in earlier issues of the Bulletin, *a list of which was given in a note preceding the article on "Choice of Techniques" in the fourth issue (Sales No.: 60.II.B.2). As indicated in that note, the problem of capital intensity has been dealt with, in these studies, on a macro-economic or over all national planning level, and a micro-economic or industry and plant level, respectively.*

The purpose of this article is to explore some of the issues involved in developing operational criteria for selecting the appropriate capital intensity at these two levels, namely, in planning the economy as a whole and the development of its main sectors, on the one hand, and the construction and operation phases of specific industrial projects, on the other.

The article is a revised version of a paper submitted by the United Nations Secretariat to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas, held at Geneva from 4 to 20 February 1963, and to the Seminar on Industrial Development Programming in the Latin American Region, held in São Paulo, Brazil, from 4 to 15 March 1963.

INTRODUCTION

INDUSTRIALIZATION IS A phase in a country's development in which its more or less stagnant economy is transformed into a self-generating, developed economy capable of ensuring high and rising levels of living to the population. There is general agreement among economists that the conditions for industrialization are different and much less favourable in the under-developed countries of Asia, Africa and Latin America than they were in the corresponding phase in the now highly developed countries. High rates of population growth and lower average levels of income, combined with the "revolution of rising expectations", make the process of industrialization in the under-developed countries more difficult, as well as more urgent, emphasizing the importance of a greatly accelerated pace of development.

Industrialization has three interrelated but distinct aspects. First, it connotes conscious application of science and technology to the processes of production and distribution, making a radical break with centuries-old production processes based on ancient empirical techniques handed down from one generation to another. The adoption of new production techniques derived from the conscious application of science and technology usually entails the acquisition of new skills and work habits on the part of the labour force. Second, key sectors of the economy are interdependent and organically linked with one another in the integrated development of the whole economy. There is a notable increase in the relative

weight of the industrial sector in the economy in the course of its development and it becomes a dynamic force in modernizing other sectors of the economy by providing them with more efficient capital goods. Finally, the rates of domestic saving and capital formation have to be stepped up to the levels where they can provide for the increase in population, ensure a rise in per capita consumption and reduce reliance on foreign grants and other "non-commercial" foreign loans. This calls for the present domestic rate of saving of from 4 to 8 per cent of the national income to be raised to a level of from 15 to 20 per cent and for a diversification of the economy which would permit an improvement in the balance of payments position by expanding the potential for exports and promoting import substitution.

Industrialization in most under-developed countries has to take place in conditions of considerable initial under-employment, scarcity of capital and acute shortage of foreign exchange resources. In this phase of development the problem of widening work opportunities so as to achieve full employment is important not only in terms of relieving misery, but also in terms of utilizing most efficiently the abundant factor of production in the form of labour. It is in this context that choice of capital intensity in operational planning needs to be examined.

THEORETICAL DISCUSSIONS

THEORETICAL DISCUSSION OF the subject of capital intensity reveals two distinct trends, one favouring labour-intensive techniques and the other capital-intensive techniques.[1] Those who prefer labour-intensive techniques focus attention on the factor endowment of under-developed economies in the form of a relative abundance of labour and a scarcity of capital. This preference is expressed in two forms: the rate of turnover criterion[2] and the relative social marginal productivity criterion.[3] The latter aims at maximizing the social marginal productivity, that is, maximizing the output of the economy as a whole. As there is virtually no loss of alternative outputs on account of the withdrawal of labour from agriculture or from drawing upon the pool of unemployed, the social opportunity cost of labour is considered to be nil. This criterion, therefore, implies the maximization of the social marginal productivity of capital and coincides with the rate of turnover criterion. Both criteria thus aim at the maximization of immediate output and employment through the use of labour-intensive techniques.

Another group of economists suggests that the rate of investible surplus created in producing a unit of output should be made the basis of the selection of capital intensity. Since workers have a high marginal propensity to consume, and owners of capital (governments, corporations and private individuals) have a high marginal propensity to save, the employment of capital-intensive techniques will result in greater savings and investment, and, consequently, a higher rate of growth in subsequent periods of time, than that obtained by employing labour-intensive techniques.[4] The higher rates of investment will in the long run result in greater volumes of output and employment than would be obtained by employing labour-intensive techniques.

Employment of labour-intensive techniques and the consequent maximization of immediate output and employment would lead to the maximization of consumption in the immediate future. The use of capital-intensive techniques and consequent maximization of growth rates and outputs in subsequent periods would lead to maximization of consumption in the later periods, possibly at the expense of consumption in the immediate period. There is, in essence, a conflict between present and future consumption. However, it is admitted that the quantitative importance of this conflict varies in relation to the degree of effective control exercised on the real wage rate through taxation, cost price and other direct and indirect controls. Attempts have been made to find a way out of this conflict by using time discount which inevitably involves political value judgements.[5]

There are considerable difficulties in translating these theoretical conclusions into operational planning. The statistical information required for working out time preference for consumption at different points of time is not readily available. The assumption of an invariant real wage rate during the time horizon taken into ac-

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[1] The trend favouring capital intensive techniques emerges at a chronologically later stage than that favouring labour-intensive techniques.

[2] *See* J. J. Polak, "Balance of Payments Problems of Countries Reconstructing with the Help of Foreign Loans", *Quarterly Journal of Economics* (Cambridge, Massachusetts), February 1943, and Norman S. Buchanan, *International Investment and Domestic Welfare* (New York, H. Holt and Company, 1945).

[3] A. E. Kahn, "Investment Criteria in Development Programmes", *Quarterly Journal of Economics*, February 1951.

[4] *See* Maurice Dobb, "A Note on the So-called Degree of Capital Intensity in Under-developed Countries", *Economie appliquée*, vol. VII, No. 3 (Paris) and "Second Thoughts on Capital-Intensity of Investment", *Review of Economic Studies*, vol. XXIV (Edinburgh); W. Galenson and H. Leibenstein, "Investment Criteria, Productivity and Economic Development", *Quarterly Journal of Economics*, August 1955; K. N. Raj, "Small-Scale Industries—Problems of Technological Change, *Economic Weekly* (Bombay), 7 and 14 April 1956 and A. K. Sen, *Choice of Techniques—An Aspect of the Theory of Planned Economic Development* (Oxford, Basil Blackwell, 1960). A detailed discussion of this type is to be found in "Capital Intensity in Industry in Under-developed Countries", *Industrialization and Productivity Bulletin*, No. 1 (Sales No.: 58.II.B.2), pages 10 and 11.

[5] A. K. Sen, *Choice of Techniques*, op. cit., chapters VII and VIII.

count in working out time discounts is unrealistic, for, with the growth of capital accumulation, the relative prices of labour and capital are likely to change in favour of the former factor. The conclusions are based on the assumption that there will be a continuing flow of labour from overcrowded agriculture into industry without affecting the real wage rate or without incurring considerable costs in social overhead, such as housing, schools and the like. This assumption is not borne out by experience. The implicit assumption of a high elasticity of substitution among factors of production and commodities is also not justified. Finally, only two factors of production are dealt with—labour and capital. This ignores the existence of such scarce factors as skilled labour and managerial skills which have also to be taken into account.

ESTIMATION OF CAPITAL INTENSITY

IT IS NECESSARY to distinguish two phases of an investment project, the construction phase and the operating phase (or manufacturing phase in industrial projects). A number of alternative techniques involving different combinations of labour and equipment may be available and should be taken into consideration in selecting the capital intensity for each phase.[6] The collection and accessibility of these primary data are indispensable in making the choice of capital intensity in operational planning.

Two factors should be noted in estimating the capital intensity of projects—investment in social infrastructure and the level of utilization of fixed capital, that is, machinery and buildings. Efficient operation of enterprises requires, on the part of the labour force, a minimum of skills to operate machinery and equipment, and habits of industrial work. This calls for a stable labour force conveniently housed near the location of the enterprises, which, in turn, means investment in social infrastructure, such as land reclamation, housing, schools, hospitals and the like. When calculating and comparing the capital intensities involved in different techniques of production, it is necessary to take into account not only investment in machinery and installations, but also investment in social infrastructure. Such expenditure assumes considerable quantitative significance in the case of steel plants, fertilizer factories and other projects which are built near their sources of raw materials and involve building new towns or settlements. It may become an important item of total investment once the pool of unemployed in the urban area is exhausted and additional labour has to be drawn from the surrounding rural areas; the larger the number of workers required in the operating phase, the greater will be the expenditure on social infrastructure. In technical language, the choice of capital intensity in the operating phase of a project has to be determined in conjunction with such factors as external economies and dis-economies.

As to utilization of equipment, it is possible to combine different quantities of labour with a machine or a plant, by means of multiple shifts, staffing in each shift, use of incentives, levels of repairs and maintenance, etc., to yield different levels of output.

The "conservative estimates" made by one expert in India disclose that, from a given fixed investment, the output and employment in hand-fed operations can range from 1.00 to 6.42 and from 1.00 to 5.35, respectively, depending on the pattern of management. In semi-automatic operations, the range for output can be from 1.00 to 5.56 and for employment from 1.00 to 4.45.

Table 1 illustrates the range of variation in this area. The figures in the table indicate that, depending upon

[6] On a macro-economic level, the construction phases of all projects taken together constitute the construction sector, while other sectors of the economy comprise the operative phases of the projects.

Table 1

ESTIMATED RANGE OF POSSIBLE OUTPUT AND EMPLOYMENT FROM A GIVEN QUANTITY OF FIXED CAPITAL IN INDIA

Patterns of management	*Hand-fed operations*		*Semi-automatic operations*	
	Index of production	*Index of employment*	*Index of production*	*Index of employment*
Poorly managed with one shift	1.0	1.0	1.0	1.0
Well managed with incentives, conventional staffing and one shift	1.5	1.05	1.3	1.0
Well managed with incentives, intensive staffing and one shift	1.95	1.36 to 1.53	1.43 to 1.69	1.0 to 1.3
Well managed with incentives, intensive staffing and three shifts	5.50	4.08 to 4.59	4.03 to 4.77	3.0 to 3.9
Well managed with incentives, intensive staffing, three shifts and a seven-day work week	6.42	4.76 to 5.35	4.70 to 5.56	3.5 to 4.55

management, there is a wide variation in the "effective" capital intensity for the same plant and equipment. The management element should be taken into account in estimating the capital intensity of a given technique. This element, in turn, has implications in terms of training and improving managerial skills.[7]

[7] These figures also reveal the potential of expanding output in the operating phases of existing enterprises in under developed countries by improved management. On the management aspect, *see* United Nations, *Management of Industrial Enterprises in Under developed Countries* (Sales No.: 58.II.B.5).

GUIDE-LINES FOR THE CHOICE OF CAPITAL INTENSITY

Policy making authorities must make decisions regarding capital intensity for individual sectors of the economy and for the economy as a whole, and they require some working rules or guide-lines for this purpose; it is in the light of these guide-lines that engineers and technologists can select techniques of production for various projects, redesign or modify plant and equipment and develop appropriate techniques of production. Some of these guide-lines are outlined in this section.

The rational use of limited resources available for the industrialization of a country requires a long-term strategy of development. This strategy should be worked out on the basis of the initial stage of development with reference to such factors as the social, economic and administrative infrastructure, size and growth rate of the population, known physical resource endowment and the present and prospective importance and structure of foreign trade. For example, India's strategy of development, with its vast population (large potential market), diverse natural resources and limited potential for exports, will be different from that of a country with a small population, abundance in one key exportable natural resource—petroleum or natural gas, for instance—and consequent large export potential and favourable foreign exchange position.

A perspective plan with goals of given increases in per capita income and consumption within a specified time limit (for example, a 100 per cent increase in per capita income and a 75 per cent increase in per capita consumption within twenty-five years) is elaborated on the basis of the long-term strategy of development. This plan will also govern the priorities and patterns of investment among individual sectors of the economy. It provides the basis for the medium-term plans in which the rates of growth and investment are scheduled so that the specified goals are achieved in the last year of the specified time horizon. The perspective plan is continually revised in the light of experience, achievements and changing economic circumstances. At the same time, the time horizon of this plan is being extended by the length of the completed medium-term plan.

The long-term strategy of development, the ensuing priorities and patterns of investment in the perspective and medium-term plans and the relationships of interdependence among sectors of the economy (for example, the relationship between agriculture and the industrial sector, and the dependence of manufacturing industries on supplies of raw materials, power, transport and trained manpower) may often have to be worked out independently of immediate employment considerations.

The stage has been set for selecting capital intensities once the broad outlines of the medium-term plan are determined, including approximate targets of annual growth rates of national income, consumption and investment. The most important point at this stage of elaborating the medium-term plan is to focus attention on *the number of additional workers (and the total number of workers) that can be employed during the plan period*, rather than on the total number of existing unemployed or under-employed workers. Assuming the availability of complementary equipment, even in its most rudimentary form (say, spades and baskets), the most important limiting factor on expansion of employment is the available supply of food and other wage goods which determine the real wage rate. The volume of employment is inversely related to the level of the minimum real wage rate that is politically feasible in a given situation.

Various direct and indirect measures of control, such as tax measures (especially commodity taxes, lowering the limit of exemption from income taxes, land revenue, etc.), "safe" limits of deficit financing (that is, permissible increases in the general price level), price controls and compulsory procurement of food, cloth and the like, amount, in essence, to distributing the available supply of consumer goods among the largest possible number of employed persons. Theoretically speaking, the ceiling on employment might be full employment of the entire labour force if it were possible to achieve a sufficiently drastic cut in the real wage rate.

The creation of employment to the level of a "ceiling" arrived at by various considerations of an economic and political nature represents the maximum utilization of labour (the abundant factor of production) feasible under the given circumstances, and represents the key factor in determining capital intensity. It should be noted that such a ceiling embraces the labour force to be employed in all projects and in all sectors of the economy.

The feasible maximum number of additional jobs that can be created in the plan period is arrived at by subtracting the existing level of employment from the ceiling thus obtained. The planning authorities may find two possible situations: the new employment that would be created by the use of the most labour-intensive techniques in every project in the plan may be less than or roughly equal to the feasible maximum number of additional jobs, or it may exceed it. In the first case, the decision on the choice of capital intensity is relatively easy, namely, to use the most labour-intensive techniques in every project.

Road-building with picks and shovels at Faridabad, near Delhi, India

View of the carding machine section in one of the largest fully mechanized textile mills in West Bengal, India

Worker in a modern small-scale leather factory in the Philippines putting a hide through a setting machine

However, in most under-developed countries, it is possible to undertake simple projects, such as irrigation, housing, road building and the like, with the help of simple tools. These tools are either already available or can easily be manufactured locally; alternatively, they can be imported by spending a small amount of foreign exchange. Consequently, it should be possible to create new employment of this type in almost all countries unless inadequate organizing or managerial ability operates as a bottleneck in the execution of projects. Even if such a bottleneck does exist, it is possible to overcome it within a short period by training suitable personnel. Inability to create new employment in the plan period equalling the feasible maximum number of additional jobs implies a failure to utilize fully the potential resources for realizing the maximum pace of development. The first situation, therefore, is likely to be, at best, a temporary one and most under-developed countries are already likely to be found, or will soon be found, in the second situation.

The choice of capital intensity in the second situation is a complex task requiring the selection of differing capital intensities for different projects in such a way that the new employment created by them is roughly equal to the feasible maximum number of additional jobs in the plan period. The use of the maximum capital-intensive techniques is almost certain not to fulfil this condition. It is, therefore, necessary to discover how best this possibility of differential capital intensities can be utilized in the interests of the economy.

Historical evidence indicates that the cost of labour relative to the cost of capital will increase over time once accumulation of capital outruns growth in the labour force, that is, the value of equipment per worker begins to increase. This trend, in most countries, is reinforced by the enactment of minimum wage legislation (reflecting social conscience and rising expectations), unionization of labour and a steady increase in the opportunity cost of the transfer price of labour from agriculture to other sectors of the economy.[8]

This means that labour costs, that is, operational costs, will rise over time. This trend element should be taken into account in working out differential capital intensities for individual projects. A distinction was made earlier between two phases of an investment project, the construction phase and the operating phase (or manufacturing phase in industrial projects). The increase in the cost of labour relative to capital over time will affect only the operating phase. It is, therefore, preferable to use more capital-intensive or less labour-intensive techniques in the operating phase of projects than in the construction phase. In other words, the construction activities throughout the economy should receive top priority in the use of labour-intensive techniques.

[8] As workers begin to move from overcrowded agriculture to other sectors of the economy, average employment and income of the labour force retained in agriculture will increase. This, in turn, will lead to an increase in the wage rate that will have to be offered to workers in agriculture to induce them to take up employment in other sectors of the economy.

The techniques designed for the operating phase are embodied in machinery and equipment. The impact of the rise in future operating costs is in proportion to the length of time over which the machinery and equipment will continue to be in service. The relevant time horizon comprises (i) a gestation period, or the time taken up in the installation of machinery and equipment, and (ii) the lifetime of the machinery and equipment. The longer the relevant time horizon (gestation period plus the life of the plant), the higher should be the capital intensity of the techniques chosen. For example, some of the major transport installations, such as railways and ports, provide services for a very long period (fifty years or more) and should, consequently, embody relatively higher capital intensity than others with a shorter time horizon.

A distinction should be made between the production operations which can be mechanized without undue additional costs at a later stage and processes whose subsequent mechanization would involve heavy additional costs. The latter should embody relatively more capital-intensive techniques than the former. This proposition is merely a corollary of the preceding proposition about a relative time horizon.

Immediate cost effects of the choice of capital intensity cannot be altogether neglected. They have special relevance in mixed economies. Their maximum impact falls on those enterprises manufacturing important intermediate products, and on those whose time horizon is long.

To sum up, the following guide-lines should be followed in the choice of differential capital intensities. First, to the extent that it is technically and organizationally feasible, labour-intensive techniques should be employed in the construction phase of all projects. Secondly, in the operative phase, a system of techniques in descending order of capital intensity (progressively less capital-intensive or more labour-intensive) should be selected in (i) machine manufacturing projects and transport installations with a long time horizon (as defined earlier); (ii) other basic industries projects producing important intermediary products and services; also, those with a long time horizon, and (iii) all other projects. Special consideration should be given to export industries projects facing competition in the world market from developed countries. Within this system of preference in capital intensities, production operations in the operating phase of a project which cannot be subsequently mechanized without additional heavy costs should embody relatively higher capital-intensive techniques. The aggregate new employment generated in all projects using the above-mentioned scale of capital intensities should be approximately equal to the feasible maximum number of additional jobs in the plan period.

Application of these guide-lines will enable planning authorities, to the extent possible, to select factor proportions consistent with the maximum use of labour within the given institutional and social limitations, prevent an uneconomic structure of costs of production and losses arising from technological obsolescence and safeguard export industries facing foreign competition.

TECHNOLOGICAL POSSIBILITIES FOR LABOUR-INTENSIVE TECHNIQUES

THERE IS A general tendency in under-developed countries to employ the most up-to-date techniques in all sectors of the economy and for all types of operations. Up-to-date techniques are mostly capital-intensive because they are developed in advanced countries and are generally aimed at substituting capital for labour because of rising wage costs and increasing abundance of capital. In the first place, capital-intensive processes are often identified with "industrialization" and have a prestige appeal. Engineers often have a psychological bias in favour of such techniques because of their educational background and their conscious or unconscious identification of the latest available techniques with "progress". Business managers often prefer them in order to avoid irksome labour problems. This constellation of forces operates against the use of the economically correct factor proportions. It is, therefore, useful to draw attention to areas of industrial activities which might be usefully considered for deploying or developing capital-saving and more labour-intensive techniques.

Blacksmith trainees at work in the Central Training Institute in Calcutta

There is great scope for employing labour-intensive techniques in the construction phase of all projects. At one extreme will be found almost completely manual methods of high labour intensity, including human carriers (or animal power); at the other extreme, completely mechanized operations of excavation, levelling and hauling. A number of alternative techniques involving a wide range of different combinations of labour and equipment are thus available for construction activity.[9] Earth-moving operations, including excavation, hauling, filling and compacting, are particularly adaptable to the use of highly labour-intensive techniques. The use of such techniques has, by and large, no adverse effect on the quality of the end product (houses, factory buildings, dams, canals, roads, etc.).[10]

Employment of labour-intensive techniques in the construction phase of all projects is also important because the unemployed and under-employed workers in under-developed countries form a group of largely unskilled workers. A study prepared by the Department of Economic and Social Affairs of the United Nations Secretariat[11] reveals that the share of total construction activity in incremental gross fixed capital formation in the economy is, on the average, higher in under-developed countries than in developed countries and varies in the former from 46 per cent to 69 per cent.[12] "Even in modern industrial countries constructional activity, which lends itself to hand labour, is as much as 50 or 60 per cent of gross fixed investment, so it is not difficult to think of labour creating capital without using any but the simplest tools."[13]

Data on cost elements of earth-moving operations by different techniques are given in table II in the appendix to this article. It should be noted that earth-moving operations are quite important, even in the construction of industrial enterprises. For example, the construction of the Rourkela Steel Plant in India (including the township and so forth) involved 6.1 million cubic metres of earthwork.[14]

There are a number of "technologically flexible" industries which allow for considerable substitution between labour and capital and which are therefore amenable to the use of labour-intensive techniques in the manufacturing phase. In weaving cloth, for example, there is a spectrum of techniques involving different combinations of labour and capital ranging from primitive throw-shuttle hand looms through fly-shuttle hand looms, semi-automatic hand looms, cottage power looms and factory non-automatic power looms to automatic power looms. The case of wood-working technology also falls in the same category.[15] Cotton spinning, clothing, foodstuffs, leather, rubber products, bricks, roofing tiles, certain chemicals, brass utensils and steel furniture are other examples of technologically flexible industries.

Manufacture of a number of goods, such as radios, television sets, bicycles and agricultural equipment, in-

[9] *See* "Capital Intensity in Heavy Engineering Construction", *Industrialization and Productivity Bulletin*, No. 1.

[10] The pyramids in Egypt and the Taj Mahal in India conclusively demonstrate this fact.

[11] "Capital Intensity in Heavy Engineering Construction", op. cit.

[12] *Ibid.*, page 36. *See* table I in the appendix to the present article.

[13] W. A. Lewis, "Economic Development with Unlimited Supplies of Labour", *Manchester School of Economic and Social Studies*, May 1954, page 161.

[14] Government of India, *Report of the Ministry of Steel and Fuel (Department of Iron and Steel), 1960-61* (New Delhi, 1961), page 14.

[15] G. K. Boon, "Choice of Industrial Technology: The Case of Woodworking", *Industrialization and Productivity Bulletin*, No. 3 (Sales No.: 60.II.B.1).

volves production and assembly of components. These examples also represent technologically flexible industries because it is possible to organize production of their components in accordance with the specifications of the assembly plants by means of labour-intensive techniques under sub-contracting arrangements. This method of using labour-intensive techniques has been extensively employed in Japan. Again, these techniques can be efficiently employed in the manufacture of accessories for the automobile industry, for railways, shipping and the like.

The existence of a market for second-hand machines which have become obsolescent in advanced countries on account of rising costs of labour is, in a way, an index of the scope of the technologically flexible industries. It may be advantageous to employ second-hand machines in several cases: first, because they often represent equipment of lower capital intensity and techniques of higher labour intensity, and second, because, on account of their shorter life, they permit a more flexible equipment policy by making it possible to shift to new or different equipment at an earlier date in the future than would have been the case with new equipment.[16] Alternatively, they provide the prototype design of equipment embodying relatively more labour-intensive techniques for manufacture in under-developed countries.

There is a clear distinction between ancillary or auxiliary processes and "core" operations in industrial enterprises. The former consist of materials handling, warehousing, packaging, flying squads and maintenance shops for core operations, tool maintenance and tool making rooms, utilities and the like. It is possible to use labour-intensive techniques in some of these ancillary processes even in technologically inflexible industries where it is difficult to replace capital by labour in the core operations.

The attention of engineers, scientists and technicians should be drawn to the possibilities of selecting capital-saving techniques in the core operations of the technologically inflexible industries. Research and development of such techniques should be undertaken where they do not exist. This can sometimes be done by designing the equipment on the basis of the process layout instead of the product or line layout, especially in engineering industries. There exists great scope for research in designing equipment and developing processes to reduce the scale of operations with a minimum increase in operating costs. (In technical terms, this would amount to reducing the slope of the curve of the economies of scale.) This type of research has considerable importance because in many under-developed countries the size not only of the present market, but also of the potential market in the foreseeable future, is likely to be relatively small.

Recent developments in the technology for ammonia production illustrate this point. While the average plant for ammonia production has a capacity of from 250 to 300 tons per day, a recently developed "packaged" plant has a capacity of only sixty tons per day. This plant is made up of separate sections mounted on skids. Each section can be transported by truck or by rail. Installing the plant is easy and takes less than thirty days. After the cement pad has been prepared, the sections are bolted to it, about 100 pipe connexions are made, and the plant is ready to start production. The production cost of liquid anhydrous ammonia in this plant has been estimated at about $36 a short ton compared with $32 a short ton for a plant with a capacity of 300 tons a day. Packaged plants are also being developed for the preparation of compound fertilizers—ammonium nitrates, ammonium sulphates, urea and various ammonium solutions—from liquid anhydrous ammonia.

The petroleum industry has made new strides in oil refining and has developed midget refineries with capacities up to 10,000 barrels per day, although previous concepts of refinery design had set the minimum economic capacity at over 25,000 barrels per day. More than a dozen midget refineries, including four with a capacity of 5,000 barrels per day each, are under construction at present, most of them in newly developing countries. The reduction in the minimum economic capacity of refineries has been made possible by a simplified flow scheme and the fact that each processing unit serves at least two important functions instead of one as in the case of the large unit. The construction of improved small-scale vertical kilns for cement manufacture and substitution of multi-purpose equipment for single-purpose machinery in a variety of industries are other examples of technological developments aimed at reducing the scale of operations with a minimum increase in operating costs.[17]

The advantage of large-scale production over small-scale production in unit costs is derived in part from purely technological economies of scale and in part from the facilities of economic "overheads", such as research, bulk buying and selling, cheaper and easier credit facilities, advertising, standardization of products, specialized facilities for tooling and repairs, organization of specialized maintenance staff, facilities for specialists' advice and so forth. The latter facilities—of economic overheads—can be provided to small production units by surrounding them with appropriate agencies—private, co-operative or statutory—which can take over the functions of economic overheads and perform them as common services to small units. Important among these agencies are state-sponsored industrial finance corporations, industrial extension services, sale and purchase co-operatives, industrial research institutions, corporations supplying machines on a hire-purchase basis, firms specializing in tooling, repairs and the like, credit co-operatives, and so on. The chief advantage of industrial

[16] Netherlands Economic Institute, *Second-hand Machines and Economic Development*, Publication No. 15/58 (Rotterdam, May 1958).

[17] For details about the use of small scale vertical kilns and multi-purpose machinery, *see* "Adaptation of Processes, Equipment and Products" in *Industrialization and Productivity Bulletin*, No. 6 (Sales No.: 63.II.B.1), pages 17 and 18.

estates consists in the incorporated common services performing many of these functions of economic overheads. Failure by engineers and technicians to distinguish between unit cost advantages arising from purely technical economies and those from other economies not infrequently results in adoption of more capital-intensive techniques than can be justified under the circumstances.

It should be recalled that research in and application of labour-intensive techniques should be organized in accordance with the guide-lines on differential capital intensities in individual sectors within the framework of the average capital intensity for the economy arrived at by the planned volume of investment and the ceiling on employment.

Appendix

Table I

IMPORTANCE OF CONSTRUCTION EXPENDITURE IN NATIONAL EXPENDITURE, SELECTED COUNTRIES, 1953
(Percentage)

Country	Share of gross fixed capital formation in gross national product	Share of construction in gross fixed capital formation	Non residential construction		Share of construction industry in total factor payments[a]
			As percentage of total construction	As percentage of gross fixed capital formation	
Industrial countries:					
Germany (Federal Republic)	20.6	47.4	...	...	6.6
Netherlands	20.7	46.5	62.4	29.0	5.4[b]
Norway[c]	29.2	50.0	54.8	27.4	8.5
United Kingdom	13.4	51.7	48.2	24.9	5.8
United States[c]	16.1	58.6	61.4	36.0	4.6
Other countries:					
Argentina[d]	15.5	68.8	...	...	5.0
Brazil	14.2	57.5	...	...	...
Burma	14.1	76.5	...	...	2.8
Chile	9.3	60.4	46.4	28.0	3.2
Ecuador	11.1	46.3	74.6	34.5	2.9
Ghana	13.3	54.2	80.8	43.8	...
Israel	23.7	70.8	53.7	38.0	5.8
Philippines	6.8	62.1	63.2	39.2	3.3
Union of South Africa	26.5	56.1	...	...	...
Yugoslavia[d]	32.0	48.5	...	...	7.2

Source: Statistical Office of the United Nations, *Statistics of National Income and Expenditure*, Statistical Papers, Series H, No. 10, January 1957, which contains the definition of each item and national differences in coverages and definition.

[a] Payments to factors of production in the construction industry as a percentage of gross domestic product at factor cost (total factor payments): for Chile, Israel and the Philippines, of net domestic product at factor cost.

[b] 1950.

[c] Government fixed capital formation excluded in part from capital formation.

[d] Gross material product; capital formation includes changes in inventories. For definition of concept of gross material product, *see* source.

Note: This table has been reproduced from the article "Capital Intensity in Heavy Engineering Construction" which appeared in the first issue of *Industrialization and Productivity Bulletin*.

Table II

CAPITAL INTENSITY AND UNIT COSTS FOR A COMBINED OPERATION OF EXCAVATION, TRANSPORT AND COMPACTION

Country	Capital input (dollars per thousand cubic metre-kilometres) (1)	Labour input (man-hours per thousand cubic metre-kilometres) (2)	Capital-labour input ratio ((1):(2)) (3)	Cost per cubic metre-kilometre (dollars) (4)	Wages (dollars per hour) (5)	Year (6)
France	167	148	1.1	0.67	0.71	1958
India	190	600	0.3	0.60	0.13	1953
Poland[a, b]	48	957	0.05	0.62	0.21	1952–1954
Union of Soviet Socialist Republics[a]	180	158	1.2	0.67	1.04	1956

Source: "Capital Intensity and Costs in Earth-moving Operations", *Industrialization and Productivity Bulletin*, No. 3, page 13.

[a] For details on exchange rate used in calculation, *see* source.

[b] Capital and labour inputs based on distribution of costs for entire project.

Seminar on Industrial Development Programming in the Latin American Region

A SEMINAR ON INDUSTRIAL Development Programming in the Latin American Region was held in São Paulo, Brazil, from 4 to 15 March 1963. It was organized jointly by the United Nations Economic Commission for Latin America (ECLA) and the Centre for Industrial Development in co-operation with the Bureau of Technical Assistance Operations (BTAO) of the Department of Economic and Social Affairs of the United Nations Secretariat and was sponsored locally by the Executive Groups of the Brazilian Industry (GEIA, GEIN, GEIMAPE, GEIMAR and GEIMET), the National Confederation of Industries of Brazil and the Federation of Industries of the State of São Paulo. The Seminar was attended by sixty-nine participants and observers from eleven countries of the region, four countries outside the region, and the United Nations and other international organizations.

There has been increasing recognition in Latin America of the need for economic planning and, in particular, for planning of industrial development, as evidenced by the fact that most of the Governments in the region have by now organized planning agencies to deal with these problems. It is considered that industrialization is a key element in the process of rapid economic growth of the under-developed countries. However, only in exceptional cases can the required tempo of industrial development be achieved through the autonomous operations of the market mechanism, particularly if industrialization is to be compatible with the social and political objectives of economic development currently sought by Governments. Planning and programming of industrial development have of late been increasingly recognized as a basic prerequisite for a consistent policy of industrialization and the optimal use of national resources. This calls not only for the development of effective planning techniques taking into account the particular conditions of under-developed countries, but also for the establishment of additional machinery for the formulation and implementation of industrial plans and programmes.

The purpose of the Seminar was to stimulate an exchange of views on their experiences in industrial planning among a group of specialists in this field representing the various aspects involved in the planning process. The participants were selected from among general economists, industrial economists, engineers and industrialists within and outside the Latin American region, in an endeavour to promote a mutual understanding of the problems faced in the planning process. An attempt was thus made to build a bridge between planning and policy making and the actual establishment and operation of industry. Moreover, some of the participants from countries outside the Latin American region, namely, France, India, Japan, Poland and the United States, represented areas at different stages of economic development and with different economic systems. The confrontation of the experience of these countries with that of Latin America proved to be extremely fruitful in stimulating the thinking of the Latin American participants on problems in their own areas.

Extensive documentation in the form of research studies was presented to the Seminar by the two organizing bodies, the Centre for Industrial Development at United Nations Headquarters and the Industrial Development Division of the secretariat of the Economic Commission for Latin America. A wide range of problems relating to planning and programming of industrial development, economic characteristics of industries and evaluation of industrial projects was reviewed in the Seminar. A consistent effort was made to orient the discussions towards a search for practical solutions which would be of immediate use to Governments faced with the problem of developing realistic policies and measures to promote industrial development in their countries. Among other results of the meeting, a number of areas were mapped out for further investigation.

The Seminar divided the discussion items into two main areas: programming of industrial development at the country level, and programming at the sector and project levels. The first was subdivided into the following topics: methodology of industrial programming within the general economic programming; structural changes in production and demand; selection of techniques and economies of scale, and experiences of Latin American countries and a few others in industrial programming. The main topics of discussion in the second area were: basic data and criteria for programming of a number of industries (steel making and transforming, chemicals, pulp and paper, textiles, cement, aluminium and industrial construction); evaluation of industrial projects and preparation of feasibility studies; formulation of sectoral industrial programmes for both dynamic and traditional industries, and implementation and other aspects of industry programming with particular reference to the private sector.

In discussing over-all planning and its relation to sectoral planning of industry in general and planning of individual industrial branches, the need for formulating a general national plan was explicitly recognized. It was realized that countries were facing considerable difficulties in this respect, particularly as regards statistical data and availability of programming personnel, but these difficulties were not considered to be insurmountable. However, at the present time many countries in the region were lagging in the area of over-all planning and the question arose as to what extent limited planning on a sectoral basis, which was being carried out in some of the countries of the region (Mexico and Brazil, for example), could be effective in the absence of a comprehensive over-all plan. The consensus was that countries were well advised to proceed with partial planning of their strategic or bottleneck sectors, even before they were in a position to produce an adequate over-all plan. As an example, it was mentioned that even in the case of a centrally planned economy such as Poland, in the early stages of planning a major effort had been concentrated on the bottleneck sectors, namely, those which had suffered a major dislocation as a result of war.

The Seminar gave its attention to the absorption of unemployment, a major factor in planning in the developing countries of the region in view of the existing high level of structural unemployment which is being aggravated by the rapid growth of the labour force. In this connexion, the possibilities of capital-labour substitution in industry were discussed, but these were generally found to be of limited scope because of the technological characteristics of modern industry. It was considered that a serious effort should be made to promote systematic technological research to explore the possibilities of increasing the flexibility of industrial processes in regard to the substitution of capital by labour. It was envisaged, however, that the manufacturing sector as a whole could be expected to have a relatively limited absorptive capacity for manpower, and that significant progress in absorbing unemployment could be made only by an over-all development effort.

The factor of economies of scale in industrial planning gave rise to a thorough discussion, since most countries in Latin America offered limited markets for manufactured goods. This limitation results either in an inability to establish industries whose minimum economic scale is above the capacity of the national markets, or, if such industries are established, in chronic under-utilization of capacity. In this connexion, the Seminar drew attention to the possibilities offered by regional integration whereby national markets would be pooled so as to permit the establishment of large-size plants which would benefit from economies of scale.

In this connexion, the question was raised of export markets for goods manufactured in the region. There were two reasons why under-developed countries should seek to expand their exports of manufactured goods. In the first place, foreign demand would in many cases be a welcome supplement to the limited domestic demand and would enable countries to engage in industries where the cost-scale factor is a leading consideration. In the second place, promotion of exports of manufactured goods would result in diversifying the structure of exports of countries whose foreign trade is at the present time concentrated on exports of primary commodities; such diversification would contribute towards reducing the impact on the economies of the developing countries of the fluctuations in demand and prices of primary commodities. A number of factors were reviewed by the Seminar, which at the present time were handicapping the expansion of exports of manufactured goods. These were, in particular, inertia on the part of the entrepreneurs in the traditional industries, ignorance of export practices and markets, and, as one of the major factors, lack of credit facilities to finance export operations.

Following the discussion of the general aspects of planning, the Seminar went on to examine the experience of individual countries in general and industrial planning. A review was made in particular of the experience in a number of Latin American countries of the ECLA/BTAO Advisory Groups, which have been an effective instrument developed by ECLA for assistance to Governments in this field. A presentation was also made of the experience of certain countries of the region in sectoral programming of specific industrial sectors. This applies, in particular, to the work on programming of mechanical industries in Peru which had been carried out by an ECLA team, and to the experience of Brazil in certain industrial sectors (for example, the establishment of an integrated industry of automobile parts and the development of heavy mechanical construction and naval construction industries) through the device of the so-called Executive Groups. Under the latter, special *ad hoc* authorities in charge of programming and the execution of the programmes of the respective sectors were established, in co-operation with the private industrial groups concerned.

In this context, the Seminar also benefited from the contribution made by the participants from outside the region who presented and analysed the experience in industry planning of certain countries, namely, France, India and Japan. These three countries shared the common feature of active participation of the private sector in the elaboration and implementation of industrial planning, under the leadership of the public authorities, which provided the basic framework of objectives, goals and targets, although the "intensity" of the planning process itself varied from country to country. Thus, broadly speaking, in France and Japan only the general objectives and over-all targets were spelled out by the Government, while implementation was largely left to the operation of the market and price mechanism; in India, government intervention in planning and implementation was of a much wider scope.

The discussion proceeded to the problem of evaluation of individual projects in connexion with the process of screening and selection. Selection of projects for implementation—or approval, in the case of projects imple-

mented by the private sector is a problem which the public authorities of most under developed countries have to face in their day-to-day operations, even in the absence of any formal planning schemes, as a matter of allocation of scarce resources among competing uses. The practices of both predominantly private enterprise economies and centrally planned economies as regards their methods of evaluation of projects were discussed; the criteria and methods used in the latter were also of direct interest to economists dealing with this problem in mixed economies. In this connexion the Seminar also examined the concept of shadow prices and its role in evaluation of projects. As is well known, this concept is applied because, under the conditions of factor endowment and factor pricing in under developed countries, market prices provide a very imperfect indication of the social cost of inputs. It was stressed by the participants that, while the theoretical value of shadow prices is generally recognized, they could be useful as a tool of practical policy making only in so far as they could be properly quantified, and that a serious effort should be made to study the experience in actual use of this concept. It was mentioned in this connexion that in the centrally planned economies, the device of shadow prices is being widely used in the evaluation of products.

The experience of the international financial institutions, the International Bank for Reconstruction and Development and the Inter-American Development Bank, in evaluating industrial projects was presented to the meeting, particularly as regards the criteria used. The latter were primarily of the conventional banking type, although some consideration was given to broader aspects of a social and economic nature. It was stressed in this context that there was need for impressing under-developed countries with the importance of having properly prepared projects; it had been the experience of banking institutions that many projects submitted for financing failed to meet normal banking standards as regards technical and financial requirements.

The problem of preparation of pre-investment studies, with a view to their being used in both screening and evaluation procedures and the preparation of "bankable" projects, led to consideration of the need for the so-called pre-investment or planning data. These data are the basic technological and economic characteristics of industries used in the preparation of pre-investment studies; the participants were careful to point out that the latter should not be confused with the more detailed and much more costly engineering studies which are undertaken at a later stage for projects whose implementation has already been decided upon. The documentation on pre-investment data presented by the ECLA secretariat and the Centre for Industrial Development for a certain number of industries (steel making and transforming, chemicals, pulp and paper, cement, fertilizers based on natural gas, aluminium, etc.) were considered to be a highly valuable pioneering effort, and it was suggested that a comprehensive and coordinated effort be made by countries and international organizations to collect and analyse in a systematic way economic and technical data derived from actual operation of industries in under developed countries.

Also presented to the Seminar by the ECLA secretariat were studies dealing with the development in Latin America of specific industrial branches, in both the traditional and the dynamic sectors, the former covering largely consumer goods industries, such as textiles, the latter, industries whose establishment could be expected to result in a more general radiating effect in the economy beyond their own sphere, for example, steel, machine building, heavy chemicals. In the case of the traditional industries, the discussion turned around the problem of the degree of modernization of their equipment which would be appropriate in the light of the conditions in the region. It was considered by some participants that a too far reaching modernization of them and the consequent increase in productivity might lead to an aggravation of the unemployment problem by releasing manpower at present employed and that the purely technological criteria of engineering efficiency should be weighed against the heavy social cost involved.

Finally, the problem of implementation of planning was discussed, in particular as regards the integration of the private sector in planning. It is clear that, in the mixed economies, a predominant part of investment and production in industry was necessarily carried out by the private sector; realistic planning should take into account the fact that the implementation of the targets provided in the plan could be carried out effectively only if appropriate incentives were provided to private enterprise in terms of normal entrepreneurial motivation to induce it to engage in these activities. It was necessary on the other hand to reconcile private entrepreneurial motivation with the general social and economic objectives of the government development policies; the two did not necessarily coincide in all cases. This meant that planning in a mixed economy implied the necessity of developing a consistent and integrated network of measures and policies destined to guide the industrialization process in the private sector in accordance with the stated objectives and targets of the plan. It was mentioned earlier that the experience of France, India and Japan presented to the Seminar offered certain lessons in this respect; in particular, the experience of France was considered relevant in view of the fact that in that country a particularly effective machinery has been developed for the collaboration of the public planning authorities with the private sector in the formulation and implementation of planning. It was considered that additional case studies by the United Nations are indicated in this field. It was also suggested that as a follow-up of the discussion, a seminar especially devoted to this problem should be convened.

Standardization in a Developing Economy

BY LAL C. VERMAN

STANDARDIZATION, WHICH, AS AN ORGANIZED MOVEMENT, IS A predominant feature of present day industrial civilization, has existed in some form or other in all human societies since prehistoric times. Primitive man's stone tools, for example, exhibit striking similarity in materials, shapes and even dimensions. The same is true of clay bricks, pottery, earthen seals and other products made in large numbers in Babylonia and Mohenjo-Daro as early as 5000 to 4000 B.C. The history of the development of standard weights and measures goes equally far back. As a regulatory force and an instrument of economic planning, however, standardization is of recent origin.

There is an intimate and to some extent unique relationship between standardization and industrial growth. Standardization is at once a cause and an effect of the phenomenal expansion of industry witnessed in modern times. Ever since the ascendancy of the factory system of mechanical production, standardization has been historically an important factor in the advancement of the science and art of production, leading to mass production techniques and automation.

There is no doubt that countries which are planning large-scale economic expansion as a means of raising the standard of living of their peoples will find standardization an essential condition for the fulfilment of their plans. To what extent the experience of developed countries could be of use to the developing countries and the theory and practice of standardization as historically evolved elsewhere could be transferred to the latter are questions of great importance which are examined in this article against the background of the Indian experience in the past fifteen years.

STANDARDIZATION IN DEVELOPED COUNTRIES

AN ACCOUNT OF the evolution of the concept of standardization to its current status in industrially developed countries will be useful at the outset. The modern phase of standardization began when the industrial revolution brought about the factory system of production. One of the most significant changes caused by the revolution was in the status of the worker vis-à-vis the machine. In earlier times, the skill resided mainly in the worker who used the machine as a tool. Gradually the skill passed to the machine and the worker tended to become its tool, a development which paved the way for important economic and social changes, and to which may be traced, in particular, the beginning of industrial standardization.

A machine is a means of performing similar motions repetitively. Designed to perform a task, it performs no other. It operates under invariable conditions of service, which means that the products of a machine become standardized and the material it works upon and the process of its operation must be held within predetermined limits of variation.

In the beginning, little conscious thought was given to this very close link between mechanized production and standardization of processes, materials and products. As scales of production increased and products of industries reached consumers in large numbers, lack of dimensional interchangeability became a source of confusion and wastage, which forced attention to the need for standardization and co-ordination between industries. A classical example was the lack of interchangeability of electrical plugs and sockets of different makes, not only among different countries but sometimes even among the regions of the same country. In the United States, the existence of many different track gauges and sizes of rolling-stock in the early period of railroad development led to one of the earliest attempts to evolve standards on a national scale.

The advent of mass production techniques firmly established the importance of interchangeability through standardization. The experience of Eli Whitney, who is considered to be the originator of mass production techniques in the United States, is of interest in this

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connexion. Whitney began his experiments in 1793 when the Government gave him a contract for 10,000 stands of arms. He had to begin from scratch, as he had no plant for manufacture. Before his time, arms were made by highly skilled workers, each of whom produced by himself all parts of a musket and assembled therefrom a distinctive instrument. Whitney's plan was to make a factory which would work like a single machine with each job divided into operational parts so that it could be executed precisely but with little skill. Various tasks were subdivided and a group of workers was kept busy at each operation. Tools for drilling, filing and milling were standardized. "From first to last a model musket was copied with precision so that every lock, for example, was exactly like every other, among thousands. When all the parts needed to form a weapon were assembled, they united much superior to a musket formed on any other plan. In case of repair, a new part exactly fitted the place of the old part and at a trifling cost."(1)[1]

In this way, men of determination and enterprise started to standardize products and processes of industry. By the time the First World War broke out, standardization had been well recognized as an industrial process capable of ensuring interchangeability not only within a given factory but also from one factory to another, and the importance of creating industry-wide standards and national standards was realized. Also, an international standardization movement began to develop early in the twentieth century. The experience of the First World War revealed further potentialities of standardization. Owing to the acute shortage of materials and technical manpower, conservation in every respect became a matter of strategic necessity. In the United States, the War Industries Board achieved conspicuous results through a process of severe standardization. Enforced restrictions on variety brought about a substantial increase in productive capacity.

With the cessation of hostilities, industries tended to revert to the traditional freedom of variety but, in the United States, the trend was checked by the publication, in 1921, of the Report of the Committee on Elimination of Wastage in Industry appointed by Mr. Herbert Hoover. The Committee inquired into the conditions of a large number of typical industries and came to the conclusion that the over-all productivity in American industries was not more than 50 per cent of the possible maximum. The Committee's report received wide publicity in the United States, particularly in the technical press and in discussions in engineering societies and associations. A nationwide movement for simplification in industry was started through the agency of the Simplified Practice Division of the United States Department of Commerce. In many cases reduction in variety ranging from 24 to 98 per cent was brought about. To cite a few random examples, 33 different lengths and 44 different heights of hospital beds were replaced by 3 types of beds of standard length and height; 49 different varieties of milk bottles were reduced to 4 and 715,20 varieties of grinding wheels to 255,800.(2) Thus, standardization—which began merely as an associate of the machine process—developed into a means of ensuring interchangeability and later emerged as a technique of simplification for the conservation of resources and productive capacity.

The Second World War brought the urgency of international standardization to the forefront. The supply and maintenance facilities of the Allies were severely strained because of differences in standards which prevented interchangeable use of tools and even of common engineering stores. Spares for American equipment had to be brought from the United States, which involved considerable loss of war effort at a critical time. Supply management during the war also re-emphasized the importance of standardization and variety reduction of materials and products and brought about the evolution of many new techniques, including operations research, value analysis, linear programming, and so on.

In the United Kingdom, a committee similar to the Hoover Committee was constituted in 1948 under the chairmanship of Sir Ernest Lemon with the following terms of reference:

> "To investigate, in consultation with the British Standards Institution and appropriate organizations, the methods by which manufacturers and users of engineering products determine whether any reduction in the variety of products manufactured is desirable in the light of technical, commercial and other considerations; to report whether these methods are adequate and what, if any, further measures should be taken by industry or by the Government to ensure that such simplifications as are determined are put into effect."(3)

The Committee came to the conclusion that in many branches of engineering industry, variety could be reduced with great benefit to the industry, trade and general consumers. Its observation on economies that could be secured through standardization is worth reproducing:

> "There can be no question that unnecessary variety of product at any stage of manufacture lowers efficiency. The loss is not confined to any one stage of manufacture, but extends to the supply of raw materials and components. It also applies to all phases of distribution and to the ultimate user. The latter is not only faced with the resulting higher prices but often with related problems of non-interchangeability, delay in obtaining non-standard spare parts, increased stocks and unnecessary design and administrative work. Because the technical and economic problems of standardization and reduction of variety are complex, it is often not realized how large are the over-all savings which can be made by increasing the length of production runs as a result of eliminating or reducing the manufacture of specials or small batches."

About the same time as the Lemon Committee investigated the conditions of British industries, another group of experts was sent to the United States by the Anglo-American Council on Productivity "to secure detailed practical evidence of the benefits which Amer-

[1] Figures in parentheses relate to the references at the end of this article.

ican producers and consumers had derived from a policy of deliberate reduction in variety in manufactured products, whether materials, intermediate components or parts, or end products". In its report, "Simplification in Industry",(4) the group summarized the advantages of standardization in the following terms:

"To the producer:

"(i) Longer runs with fewer changes on the production line;

"(ii) Reduced tooling and set-up time;

"(iii) Possibilities of increased mechanization and special-purpose plant;

"(iv) Easier training of operatives;

"(v) Simpler and cheaper inspection;

"(vi) Less capital invested in idle plant, tools and space;

"(vii) Reduction of stocks of materials, components and end-products;

"(viii) Reduced call on drawing office and design staff for special orders, leaving them free for work on new designs or improvements;

"(ix) Simpler clerical and administrative work;

"(x) Easier service and maintenance;

"(xi) Concentration of sales and advertising effort on a narrower range;

"(xii) And hence, increased productivity, leading to reduction in cost and prices and to increased sales.

"To the user:

"(i) Lower price for a given quality or performance;

"(ii) Reduced variety and level of stocks at all distribution points;

"(iii) Readier availability;

"(iv) Improved service and maintenance facilities."

APPLICABILITY OF STANDARDIZATION IN DEVELOPING ECONOMIES

HISTORICALLY, STANDARDIZATION was evolved in countries with a fairly high degree of industrialization.[2] This might give the impression that it could be introduced only where developed industries exist, for which it would perform the very useful functions of co-ordination and consolidation. If so, would not the introduction of standardization in a developing economy be tantamount to putting the cart before the horse?

There is no doubt that in most of the industrially developed countries standardization followed industrialization and grew out of the need to co-ordinate, adjust and bring about economy and harmony in the existing pattern of industries. However, in these countries, industry was built up in economic conditions basically different from those with which developing countries are faced today. The creation of a dynamic society from limited resources and often under severe population pressure usually involves national planning, direction and control to an extent hardly compatible with the laissez-faire economy of the last century. It is in the context of such planned development that the role of standardization in a developing economy has to be evaluated.

Standards come into play whenever there is transition from production to consumption, since they establish a link between the two. The transition from production to consumption occurs not only at the ultimate point of use, but also at a number of intermediary stages, both in industry and trade. The growth of industry in any country is marked by a corresponding rise in the interdependence of the different productive sectors. Each has to look to others for the supply of raw materials, machinery, components and services and each, in turn, provides similar facilities to others. The resulting complex relationship cannot be sustained unless adequate understanding of the products and processes involved is achieved at the innumerable contact points at which products pass from one hand to another, be it within a plant, or from one plant to another, or from store to householder, or for that matter from one country to another. One of the main functions of standards is to facilitate the flow of products through these transition points.(5) (6)

Apart from helping commercial movement and industrial exchanges in this manner, standards, as has been pointed out earlier, also conserve productive effort by reducing unnecessary variety, by ensuring interchangeability and making mass production possible. Thus, standards lead to the best utilization of the human and material resources of a country. For a developing country, the conservation of resources and achievement of a high level of productivity are of obvious importance. So is the need to expand exports to earn foreign exchange with which to provide for the growing needs of importing capital equipment, so essential at the initial stages of development.

In a developing economy, industrial development is often dependent on outside assistance in the form of technical personnel, industrial know-how, capital equipment, and so on, which may be extended by different industrial groups in different countries. Thus, production units in a developing country may tend to adopt and follow the pattern of standardization of the different collaborating organizations abroad. This is the time when national standards are most urgently needed and when, more often than not, they are conspicuous by their absence. Hence the prime need for a developing

[2] Organized industrial standardization is barely more than sixty years old. The British Standards Institution, the first of its kind in the world, was founded in 1901, and its counterpart in the United States, the American Standards Association, in 1918. Of the two international standards organizations, the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC), the latter and the older of the two was established in 1904.

country is to bring into being a system of national standards, which could help industries from the earliest stage of planning and design, through erection, production and distribution. It is through such an approach that the usually limited financial resources of a developing country and its indigenous materials and manpower could most effectively be put to work.

It was fortunate that in India the Indian Standards Institution (ISI) was established in the very year of the country's independence. By the time national planning was started, the Institution had already done most of the spade-work required for laying a foundation for a strong industrial base. As the country went from one five-year plan to the next and the demand for standards grew, it was possible to pre-plan the development of standards. Today the Indian Standards Institution is in a position not only to guide existing industries in their efforts to rationalize their production and institute quality control but also to help in planning future industries and in organizing export promotion measures.

As an example of the value of pre-planning of standardization, the experience of the steel economy project of the Indian Standards Institution may be cited. The aim of this project was to achieve economy in the use of structural steel by adopting standards from the stage of production of structurals through designing, fabricating and erecting to the maintenance of structures. In production, considerable emphasis was laid on rationalization of shapes and sizes of sections, whose designs had been frozen years ago. The development of new standard sections by the Institution permitted saving about 10 per cent on steel. All new mills installed in recent years in India or to be installed in the future are to produce these new sections. Cold-formed sections made from strip are now being standardized; it is estimated that this will permit saving up to 40 per cent of the material. Standards for welding equipment and accessories and codes for welding practices have been developed to provide further economies on steel by eliminating the wasteful process of fabrication involved in riveting. Similarly, improved design codes for steel structures now enable Indian engineers to use more rational safety factors and loading criteria and permit the use of more economical and up-to-date formulae for design.

It is conservatively estimated that about 20 per cent of steel might be saved if all similar measures now available to the engineer were fully implemented. In the context of a production of steel of ten million tons a year, an appreciable quantity of which is used for structural purposes, a reduction of even one million tons per year would yield a recurring saving of well over 100 million dollars, let alone all the investments, costs and effort involved in the production of such extra quantity.

A part of the steel economy project was concerned with the rationalization of the varieties of alloy and special steels required for miscellaneous industrial uses. The import to India of equipment and expert knowledge from all parts of the world had generated a demand for well over one thousand types of alloy and special steels, including tool steels. This was not only wasteful, but also precluded the possibility of developing indigenous production, which would be extremely uneconomical in view of the limited demand for each type of steel. After an extensive study, it proved possible to reduce varieties to some 130 types, to minimize the use of imported alloying elements, such as nickel and molybdenum, and to encourage the use of indigenously available alloying elements such as manganese and chromium. The project made it possible to plan the establishment of several new alloy steel plants, a number of which are currently under construction.[3]

The question may be raised why national standards should be developed instead of adopting international standards or those evolved in other countries. Before answering this question, it should be pointed out that standards, whether at a national or other level, need only be developed if they serve a common need and are likely to contribute to the over-all economy of the nation or other group or sector concerned. Once this condition is fulfilled, the answer to the question becomes obvious, namely, if an available international standard or one developed in another country may serve the interest of a particular nation, then there should be no hesitation in adopting that standard, for in the long run it is going to facilitate international co-ordination of standards and save a great deal of unnecessary duplication of effort. However, in adopting an outside standard, it may become necessary to make one or more minor or major variations dictated by the special conditions under which the national economy concerned operates. On the other hand, there are many cases in which neither national nor overseas standards exist or, even if they do exist, may be considered inadequate for the intended purpose. In either case, it becomes necessary to evolve independent national standards.

This point may be illustrated by a few examples from the Indian experience. Before the Indian Standards Institution came into being, the prevailing industrial practices in certain well-established industries such as cement, steel and non-ferrous metals, were largely based on

[3] The Latin American countries took particular interest in the work done in India with regard to standardization of steel products. A meeting of experts on steel making and transforming industries, organized by the Economic Commission for Latin America in October 1956 at São Paulo, resolved that a similar project should be undertaken in Latin America. The Pan American Standards Committee, the Latin American Iron and Steel Institute and the Organization of American States co-operated to implement the project, which began in 1961 with the training of standards engineers. For unification and simplification of steel product standards, three seminars were held under the sponsorship of these organizations in Buenos Aires (May to July 1962), Santiago (September to October 1962) and Mexico City (November to December 1962). Assistance of the Indian Standards Institution was sought in organizing these seminars, and an officer was deputed for the Santiago Seminar on Steel Products Specification and Simplification. Eleven draft recommendations for semi-finished steel products and structural steel bars were formulated at this seminar. Another seminar is being planned to evolve rational standards for steel sections. The Latin American countries are also considering standardization and rationalization of carbon, alloy and tool steels along the lines of what has been done in India.

British standards. Though, by and large, the British standards covered India's needs, it became apparent that these standards should be amended in order to meet certain specific needs of the country, in particular in respect of indigenous raw material resources. Thus, in the case of steel used for statically loaded structures, the content of sulphur and phosphorus impurities had to be relaxed so that, given the available resources of coking coal, production of steel in the country could be stepped up to meet the ever-increasing demand. In the case of Portland cement, the existing specifications had to be liberalized in respect of magnesia content so that a large number of limestone deposits in the country could be economically exploited for the manufacture of cement. Before these decisions were taken, experimental investigations and a search of overseas standards were undertaken to ensure that such liberalizations would not in any way affect the basic qualities required in the products.

On the other hand, original Indian standards had to be developed for a large number of other items, among which were glass-making, cement-testing, foundry sands, timber, indigenous natural products including spices and condiments, refractories, sports goods, building stones, and so on. In a few cases, India broke original ground and produced standards which had been found difficult to establish in industrially advanced countries; an outstanding example is the Indian standard method for olfactory assessment of natural and synthetic perfumery materials.

As a rule, every item taken up for standardization presents its own peculiar problems which have to be individually examined and solved. Whether a standard is originally developed or adapted, the intention should be to produce a national standard suited to the special requirements of the country, keeping an eye on the need for immediate or ultimate international co-ordination of standards.

FIELD AND AIMS OF STANDARDIZATION

THE BASIC PRINCIPLES and purposes of standardization remain the same whether standardization is introduced in a developed country or in a developing one. The following definitions accepted by the International Organization for Standardization(7) make this point evident:

(*a*) STANDARDIZATION—standardization is the process of formulating and applying rules for an orderly approach to a specific activity for the benefit and with the co-operation of all concerned, and in particular for the promotion of optimum over-all economy taking due account of functional conditions and safety requirements.

It is based on the consolidated results of science, technology and experience. It determines not only the basis for present but also for future development, and it should keep pace with advances.

Some particular applications are:

(i) Units of measurement;
(ii) Terminology and symbolic representation;
(iii) Products and processes (definition and selection of characteristics of products, testing and measuring methods, specification of characteristics of products for defining their quality, regulation of variety, interchangeability, etc.);
(iv) Safety of persons and goods.

(*b*) STANDARD—a standard is the result of a particular standardization effort, approved by a recognized authority.

It may take the form of:

(i) A document containing a set of conditions to be fulfilled;
(ii) A fundamental unit or physical constant—examples: ampere, absolute zero (Kelvin);
(iii) An object for physical comparison—example: metre.

The field of standardization is represented in figure 1 by a hypothetical standardization space.(8) (9) The three dimensions of this space are "subject", "aspect" and "level".

(a) *Standardization subject:* standardization subjects are material things, abstract notions, formal symbols, etc., which are suitable for being standardized, for instance, screw threads, limits and fits, graphical symbols. A group of related subjects in a certain branch of economic or

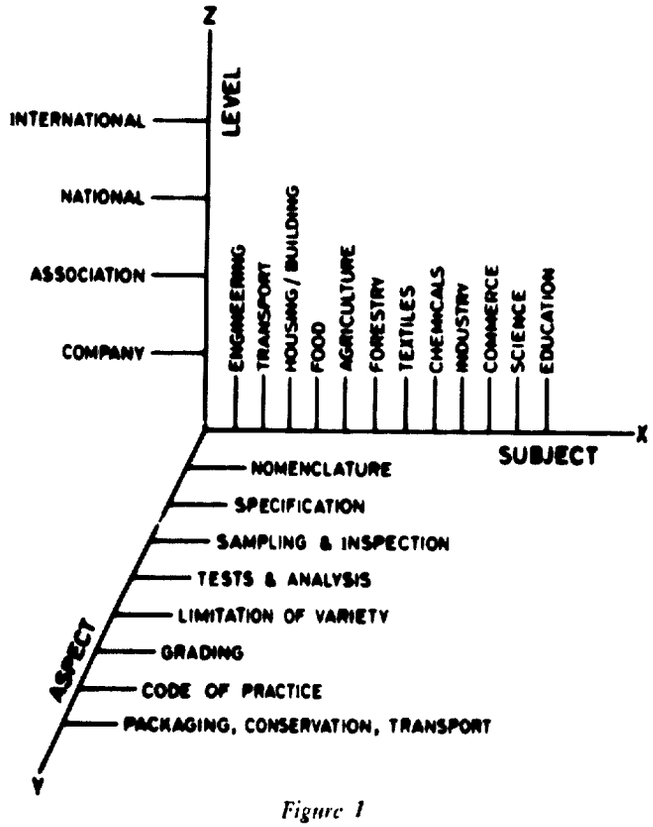


Figure 1

DIAGRAMMATIC REPRESENTATION OF STANDARDIZATION SPACE

cultural activity is considered as a standardization domain. Such groups may be constituted in different ways in regard both to the guiding principles to be followed and the extent of the domain to be defined. Some examples of standardization domains are: engineering, transport, housing and building, food, agriculture, forestry, textiles, chemicals, industry, commerce, science and education. Since there are many standardization subjects for each standardization domain, for the sake of convenience only standardization domains are indicated on the X axis of figure 1.

(b) *Standardization aspect:* a standardization aspect is a group of similar and related requirements of a standardization subject which are dealt with in a given standard. Examples of standardization aspects are:

(i) A set of nomenclature or definitions of terms;
(ii) A scheme for limitation of variety of sizes, shapes, grades or other parameters, designed to meet most economically the needs of the consumer (also including dimensional freezing of component designs to ensure interchangeability);
(iii) Construction details;
(iv) A specification for quality, composition or performance of a material, an instrument, a machine or a structure;
(v) A method of sampling or inspection to determine conformity to a specified requirement of a large batch or lot of material or products by inspection of a sample;
(vi) A method of test or analysis to evaluate specified characteristics of a material or chemical;
(vii) A method of grading and grade definitions for natural products, such as timber, minerals, etc.;
(viii) A code of practice dealing with design, construction, operation, safety, maintenance of a building, an installation, or a machine;
(ix) A code of practice for packaging, conservation or transportation of materials and products.

(c) *Standardization level:* a standardization level defines a group of persons who are to use the standard. Standards corresponding to the more important levels occurring in contemporary practice may be classified as follows:

(i) A company standard, prepared by common agreement between various departments of a company or production unit for guiding its purchase, manufacture, sales, and other operations;
(ii) An association or trade standard prepared by a group of related interests in a given industry or within a given profession;
(iii) A national standard promulgated after consulting all interests concerned, however remotely, with the subject in a country, through a national standards organization which may be a governmental, a non-governmental, or a quasi-governmental body;
(iv) An international recommendation or standard, such as those of the International Organization for Standardization and the International Electrotechnical Commission, resulting from an international agreement between independent sovereign nations having common interests.

It is obvious that the standardization space described above is not a mathematical space of either continuous or discrete variables. It is to be regarded merely as a convenient device to illustrate the various attributes of standardization, which are in the nature of independent variables.

In addition to the three above-mentioned attributes, standards may also have a fourth one. The fundamental standards of science, those of weights and measures for example, are not expected to be changed from time to time, though refinements are often made in defining and maintaining them. On the other hand, industrial standards are more temporary in character, being subject to revision with the development of science and progress of technology. In this context, standardization space may be considered to have a fourth dimension in time.

For a given standardization problem, it is possible to establish the specific aims of standardization by determining its position in the standardization space. However, there is no hard and fast division between the aims of standardization at, say, the national level as distinct from the association level. The ultimate aims of standardization are applicable to all levels, though a distinct functional character may be ascribed to standards at each specific level.

The aims of standardization in general, applicable to all levels, are to achieve:(9) (*a*) over-all economy, (*b*) protection of consumers' interests, and (*c*) safety and protection of health and life.

(a) *Over-all economy:* over-all economy comprises economy of human effort, materials and machines, power and energy, on the one hand, and the combined economy of the producer and the consumer on the other. The attainment of over-all economy creates maximum productivity for the country as a whole, though the economy of each individual unit or component of production may not be at an optimum level. For example, greatest economy in material may preclude greatest economy in labour. The pursuit of over-all economy results in simplification and reduction of variety of products and components and elimination of avoidable wastage during handling of materials, processing, transport and, in general, exchange of goods and services. Sometimes, it involves saving of essential materials by substitution with more readily available materials which may or may not lead to immediate or apparent saving in cost or human effort but which, in the national economy, may be essential for other important reasons.

(b) *Protection of consumers' interests:* Protection of consumers' interests is ensured through adequate and consistent quality of goods and services. The notion of quality of service covers not only material services such as the attainment of higher quality or performance or functional interchangeability of consumer articles, but also non-material services and conveniences, such as ready availability of standard goods from stock, sim-

plicity coupled with serviceability of consumer equipment, and generally such things as make man's life and work easier, more effective and pleasant.

(c) *Safety and protection of health and life:* Standards providing for safety and protection of health and life may concern goods in general use or materials or processes during production. Examples are standards for limiting impurities in foodstuffs, standards for storage of radio-active materials and regulations for earthing of electrical wiring and equipment.

To achieve these aims is, in a way, to introduce order in industry, trade and commerce and in human relationships generally. An eminent Indian thinker said that standardization is to industry and commerce what culture is to society. In other words, just as rules of civilized behaviour regulate the social intercourse of man and his appreciation of cultural values, so does standardization help to regulate the conduct of commerce and trade in a smooth and efficient manner, and assist in improving productivity and efficiency of man and machine.

ORGANIZATION OF STANDARDIZATION AT THE NATIONAL LEVEL

THE AIMS OF standardization imply that standards should fulfil the interests of both producers and consumers. This has given rise to a more or less universal procedure of formulating standards through intensive consultation among the interests concerned. The extent and details of such consultation may vary from country to country but rarely are standards laid down arbitrarily by a superior authority without consideration of the views of those who would have to implement or observe them or those who possess the necessary technological background.

The national standards body of a country provides the forum for consultation among the national group interests. The normal procedure is to form expert committees with representatives from producers, consumers and technologists to prepare draft standards on the basis of common agreement. The drafts are then widely circulated to every important interest concerned with the subject matter. Comments thus received are placed for further consideration by the expert committee, which takes final decisions and ensures that in the final form the standard represents the largest possible consensus of opinion within the country. It will be appreciated how a standard emerging out of such a procedure tends automatically to ensure the widest possible acceptability.

The organization of the national standards body should obviously be such as to facilitate the bringing together of the diverse interests in its forum. The status and pattern of national standards bodies in different countries vary from purely official to purely non-official depending on the socio-economic structure. In a developing country with a basically free economy, where official planning and direction coexist with private entrepreneurial initiative, a national standards body sponsored and supported by the government but working under an autonomous council of official and non-official representatives would seem to be a good pattern.

The constitution of the Indian Standards Institution is illustrative of this approach and the rapid growth of the Institution in the short span of fifteen years is ample testimony to the soundness of this principle. The Institution was set up by the Government of India in 1947 with the active support of industrial, business, scientific and technical organizations in the country (*see* figure 2). The over-all control of the Institution rests with its General Council, on which are represented industry, central and state governments, scientific organizations, subscribing members and the Division Councils of the Institution. An Executive Committee is responsible for the management of the day-to-day affairs of the Institution, which seeks advice on financial matters from a Finance Committee. The income of the Institution is derived from grants-in-aid from the Central Government, subscriptions from members (including state governments), sale of Indian standards and fees for certification marking.

In the preparation of Indian standards, the Institution functions through a large number of committees of experts called sectional committees, sub-committees and panels consisting of scientists, technologists and representatives drawn from industrial organizations, government departments, producers and consumers. These committees are appointed by the Executive Committee or by the seven Division Councils, which are responsible for the preparation of Indian standards for their respective spheres of interest. (i) Agricultural and Food Products Division Council; (ii) Building Division Council; (iii) Chemical Division Council; (iv) Electrotechnical Division Council; (v) Engineering Division Council; (vi) Structural and Metals Division Council; (vii) Textile Division Council.

A period of one to three years may elapse from the time that an item is proposed for standardization to the time when the standard is finally printed. So far, about 2,200 Indian standards have been published, covering a wide range of fields including engineering, building, textiles, chemicals, agriculture and food products, structurals, metals, electrical technology, documentation, and so on. Currently, about 400 standards are being prepared and published annually. Necessarily, priorities had to be established for effective utilization of the available resources. The development of standards for industrial raw materials and primary products received the highest priority since they formed the basis of all production and many of them were being imported. Such a situation is likely to be met with in most developing countries. Another important assignment of priority was for agricultural products, which again reflects conditions normally prevalent in a developing economy. The priori-

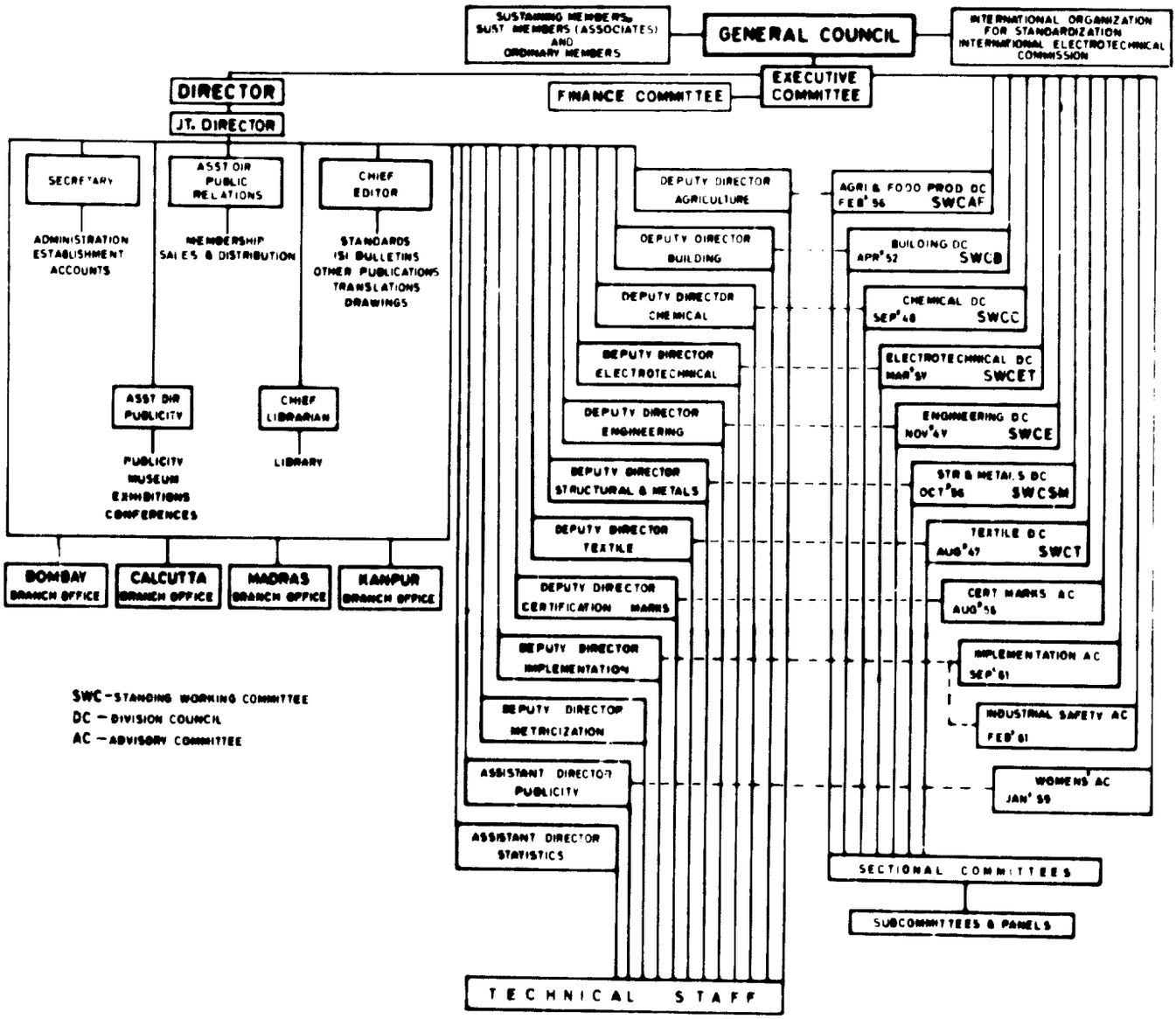


Figure 2
ISI ORGANIZATION

ties in the field of industry were assigned in accordance with the provisions of the national plans. A trend which is now gradually taking shape suggests that consumer goods may begin to receive greater attention. From the point of view of the common man, standards for consumer articles are of obvious importance and are likely to feature prominently in the standards programme not only of India but of many other countries. A recommendation of great importance which the Institution made to the Government during the very first few years of its existence led to the adoption of the metric system of weights and measures in India.

STANDARDIZATION AT THE INTERNATIONAL LEVEL

THE DEVELOPMENT OF international standards follows the same general principles and procedures as for national standards. The International Organization for Standardization and the International Electrotechnical Commission are the principal agencies for international standardization. The objective of ISO is to promote the development of standards in the world with a view to facilitating international exchange of goods and services and fostering mutual co-operation in the sphere of intellectual, scientific, technological and economic activity (*see* figure 3). As means to this end, it may:

(*a*) Take action to facilitate co-ordination and unification of national standards and issue necessary recommendations to member bodies for this purpose;

(*b*) Set up international standards provided, in each case, no member body dissents;

(*c*) Encourage and facilitate, as occasion demands, the development of new standards having common require-

ments for use in the national or international sphere;

(*d*) Arrange for exchange of information regarding work of its member bodies and of its technical committees;

(*e*) Co-operate with other international organizations interested in related matters, particularly by undertaking at their request studies relating to standardization projects.(10)

ISO membership is open to all national standards bodies. Its work is conducted through technical committees composed of delegations from member bodies wishing to take part in it.

The objectives and operations of IEC which, though organizationally distinct, functions as an electrical division of ISO, are similar to those of the latter. The scope of its work is, however, confined to electrical technology and may be described under the following two general categories:

(*a*) Work aimed at improving understanding between electrical engineers of all countries by drawing up common means of expression; unification of nomenclature; agreement on quantities and units, their symbols and abbreviations; standardization of systems of units; and graphical symbols for diagrams;

(*b*) Standardization of electrical equipment, involving the study of problems of the electrical properties of materials used in electrical equipment; standardization of guarantees to be given for certain equipment as to its characteristics, methods of test, quality, safety and dimensions controlling interchangeability.(11)

ISO was created at a conference of the United Nations Standards Co-ordinating Committee in October 1946. It maintains liaison with organs of the United Nations, the regional economic commissions, most of the specialized agencies, and a large number of international technical organizations interested in the development of international standards.

Most of these agencies actively promote the development of the less developed countries, especially in the form of technical assistance. The developing countries may find it profitable to take part in international standardization through ISO and IEC, in particular, by participating in the committees of these organizations, which may make more effective certain forms of assistance which they receive from international organizations.

International standardization through ISO and IEC is also of considerable importance in promoting external trade. The advantages to trade and industry to be able to import and export on the basis of the same international specifications for all countries are obvious. For this reason, the Indian Standards Institution has taken an active interest in ISO and IEC from its very inception. It participates in seventy-three ISO and all IEC committees, and serves as the secretariat of several of these committees.

A developing country has to safeguard its interests in international standardization as much as any other country. Special requirements to suit its state of industrial development, climatic conditions, raw material resources, and so on, need to be built into international recommendations through the action of the relevant committees. An example is provided in the recently developed tropical and subtropical standard atmospheres for testing, so often used for conditioning samples of materials prior to the specification tests applied for proving their compliance. In the beginning, the atmospheres considered for adoption by ISO and IEC were those widely used in Europe and the United States. These were unsuitable for tropical and subtropical regions where temperatures are much higher during most of the year.

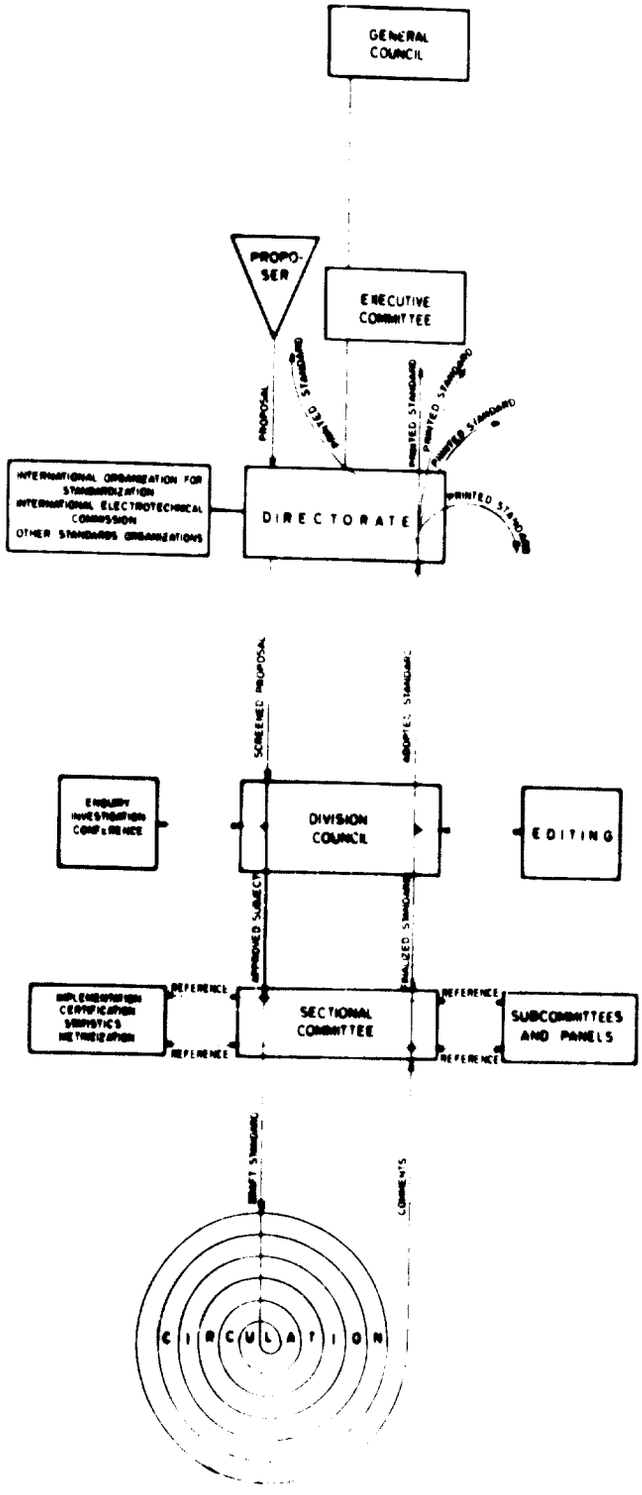


Figure 3
A STANDARD IS BORN

If European standards were adopted in these regions, testing laboratories would have to maintain costly installations for air conditioning. The Indian Standards Institution proposed a third atmosphere for tropical conditions which has been accepted by ISO and IEC. This step is of importance for all countries of the region, since it enables all materials and commodities for tropical use and export from the tropics to be tested in all countries under the most suitable internationally recognized set of atmospheric conditions.

Another example from the Indian experience may be cited. Like other developing countries, India imports a large number of machines from all over the world, many of which are equipped with electric motors. Users in India found that, because of lack of interchangeability, a motor made in one country could not be replaced by one made in another country. IEC had been engaged on this problem for several years, but could not resolve the differences between countries using the metric system and those using inch measurements. India proposed a compromise solution based on its own experience as a user country, which in due course paved the way for a single series of interchangeable dimensions adopted by IEC. Many examples could be cited where the needs of the developing countries and their knowledge and experience could facilitate the solution of difficult international standardization problems.

While ISO and IEC are world-wide institutions in which all countries with organized standardization facilities may co-operate, a number of consultative forums have been set up by groups of countries with common economic interests. These agencies implement standards within this group, and contribute to the over-all international standardization effort by resolving many differences that might exist among their members; their work often represents initial stages of international standardization, and enables them to make useful contributions to international deliberations. Some of these agencies carry on their activities through periodical conferences, meetings of technical committees and working groups, while others have established central secretariats and even institutes for research and testing. Among these organizations are: the Commonwealth Standards Conference; the European Standards Co-ordinating Committee, whose principal members are the six countries of the European Economic Community and the seven countries of the European Free Trade Association; the "ABC" conferences between Canada, the United Kingdom and the United States, which originated during the Second World War from an attempt to reconcile differences in the exchange of war equipment; the International Commission on Rules for Approval of Electrical Equipment, grouping fifteen European countries; and the Pan-American Standards Committee, whose members are seven Latin American countries, six Central American countries—represented by the Instituto Centroamericano de Investigación y Tecnología Industrial (ICAITI), which, besides its work on research and testing, extends advice on standardization matters—and the United States.

As long as the regional and sectional organizations created either by industrially developed countries or by developing countries serve the specific purpose for which they are intended and align their activities with the international work of standardization on a world-wide basis, they should be considered as welcome instruments for furthering the cause of industrial development. Among the developing countries of the world such a movement may deserve encouragement, particularly where resources for organizing independent national standards bodies are limited and where common economic interests exist.

COMPANY STANDARDIZATION PRACTICE

STANDARDIZATION AT BOTH the national and international levels lays down optimum quality or performance specifications and determines the minimum variety of products and materials required for meeting the demands of all economic sectors concerned. To ensure that the desired quality is attained in practice, standards for raw materials, designs, equipment and processes should often be developed at the level of the enterprise. The development of a system of standards for in-plant use is not necessarily restricted to technical issues and is frequently extended to administrative policies and procedures. The central idea is to simplify, rationalize and standardize company practices, whether in respect of products, raw materials, or scope of variety, or in respect of organizational matters, methods and procedures which have to be followed repeatedly.

Reference has been made to the investigations of the Hoover and the Lemon committees and the Productivity Group of the Anglo-American Council on Productivity on the economic and technical implications of excessive variety and the advantages which follow simplification and standardization. Company standardization practice provides an organizational means by which the variety of products and parts may be kept within limits without sacrificing the competitive status of the company. In developing economies, the need for variety reduction is even more acute than in the advanced countries, in particular because many of the latter are involved in promoting the industrial development of the former. The transfer of technical knowledge from the industrially developed countries brings with it a variety of industrial standards and practices requiring large numbers of materials, parts and tools which have to be continuously imported to keep up production. If the scope of variety is not reduced by standardization, industrial growth may be slowed down and a large proportion of the foreign exchange earnings of the country may be absorbed by maintenance imports.

A sample of ISI certified insecticide being analysed for active ingredient content in the laboratory of a licensed factory

Inspector of the Indian Standards Institution (ISI) examining and taking samples of flashlight dry cells in a factory licensed to use the ISI certification mark

Company standardization practice is an activity which strengthens, stimulates and complements national standardization. Standards developed for company use represent more realistically the process capabilities of existing production methods and provide readily available material on which national standards can be based. Conversely, wherever national standards have been issued, they furnish the model for fashioning and revising, if need be, existing company standards. This two-way traffic between national standardization and company standardization keeps standards alive and abreast of technological advancement and enables industries to derive the utmost advantage from standardization.

Company standardization practice as a formalized activity is comparatively new even in some industrially advanced countries. In a developing country, a great deal of promotional work is required in the beginning to create appropriate consciousness of its productivity potential, but there can be no doubt that any effort spent in this direction will be more than repaid by the gains to be achieved in industrial development. Specialized experience and knowledge to promote company standardization activity may not always be available within a developing country. Technical assistance from outside will be particularly fruitful in this area and in fact may be essential if a consciousness on the part of company management is to be brought about. India has already recognized this need and ISI is at present engaged in a special programme to propagate the idea through organized surveys and training courses.

IMPLEMENTATION OF STANDARDS

FULL BENEFITS CAN be provided by standardization only if standards are widely adopted and used in all walks of economic life of a nation, wherever they are applicable. Standards may be implemented either voluntarily or under obligation arising from existing legislation or orders of higher authority. In a developed country, where participation in standardization activity is widespread and its benefits are generally appreciated, voluntary adoption of standards presents little difficulty, but in a developing country it is often a matter of deliberately creating a consciousness and spreading the knowledge among those who stand to gain. As a rule, the social and economic structure of a country will largely determine whether emphasis should be laid on mandatory enforcement or on voluntary adoption. In a country with a completely controlled economy, there is little difficulty in making the adoption of standards obligatory on the part of every production unit. In a comparatively free economy, standards are, by and large, expected to be used without compulsion, except perhaps in certain limited spheres.

The principle of voluntary implementation of standards is derived from the fact that standards are formulated by common consent of all interested parties to satisfy an existing need and, therefore, command ready acceptance without legal pressure. Though this statement is generally true, it overlooks certain important factors. Since standards are developed to satisfy the objective of over-all economy, the economy of a particular use or an individual user may at times have to be sacrificed to some extent. Compromise between individual and over-all economy is a normal feature of standardization and it may be generally expected that implementation of standards may initially cause some hardship at some point. Besides, a better understanding of the ultimate benefits of standardization grows only with the growth of industries and then again not without a considerable effort to promote such understanding. The implementation of standards may sometimes involve a change in the existing production pattern and procedure, and the additional expenses and effort thus involved may seem at first sight unremunerative to the entrepreneur. Long-term gains and national interest should be emphasized in such cases.

In general, a great deal of persuasion and promotional work is necessary to secure the voluntary implementation of standards in the developing countries, and this phase of activity is of particular importance for the national standardization bodies of these countries. The Indian Standards Institution is perhaps the first such body which has organized an elaborate plan of publicity through paid advertisements in the press, exhibitions and fairs, films and slides, press notes, informative articles and standards conferences and conventions, held annually at different industrial centres of the country. Over the past nine years, seven such conventions have attracted large numbers of participants from all walks of the industrial and economic life of the country.

However, there are spheres of public life where the observance of standards cannot be left to voluntary action, for example, where public health or public safety are concerned. Standards of purity of drugs and foodstuffs or rules of safety for protection against electrical hazards are examples of this category. With the development of industries and the growth of the use of electricity in industry and home, there is need to be vigilant about safety to health and property. In a less developed country, this aspect is likely to be overlooked in the initial stages of development, though it deserves much more serious attention than in a developed country.

In any country, organized consumers can set the pace for the implementation of standards. If demand for standard items were large enough, producers would adjust their production accordingly. Large-scale production of standard items would make it uneconomical to supply non-standard or special products to cater to the needs of small purchasers. Thus, a cycle of demand and supply of standard goods conforming to national standards could develop.

In less developed countries, government departments and their attached or associated organizations frequently constitute the largest body of organized consumers. It is fitting for these organizations to purchase according to national standards, but a policy directive from the highest governmental authority is necessary to crystallize action and give necessary clearance to purchasing officials. Once the government takes a firm decision, it becomes possible to persuade other organized consumers in public or private enterprises to follow the lead. In India, the Central Government has given such a lead, which is being taken up by the state governments and more gradually by local authorities as well. This has largely been brought about by insisting that all government consumer departments such as railways, defence, and post and telegraph, participate actively in the formulation of Indian standards from the very beginning.

CERTIFICATION MARKING

ANOTHER EFFECTIVE MEANS to implement standards and to bring to the door of the housewife and the common consumer all the advantages of standardization is to provide certification marking facilities for goods conforming to accepted standards. A certification mark is a third-party guarantee to the purchaser that the goods have been inspected, tested and certified by or under the supervision of a competent agency and may be purchased with a reasonable assurance of quality. The primary purpose that certification marks serve is to convey this assurance when the purchaser has no readily available facility, knowledge and skill for inspection and testing or when such testing is clearly uneconomical, as is the case when the volume of purchase is small.

The principles on which certification marking schemes are formulated are twofold. First, the organization operating the scheme must be an independent and technically competent body with no business interest connected with the production, distribution or supply of goods. Secondly, the operating organization must be satisfied that the manufacturing equipment, system of inspection and method of quality control available in the factory where the goods to be certified are manufactured are adequate to ensure conformity with the accepted standards. In addition to this in-production control, an independent vigilance and a continuous check on quality is maintained by drawing samples of raw materials and finished products from the production line, stocks and the open market for tests to be conducted either by the operating organization itself or at its instance by independent agencies.

The national standards body of a country is undoubtedly the best suited agency to operate certification marking schemes, and many of them have extended their functions to this activity. The authority for operating such schemes is sometimes derived from existing legislation, which may permit the registration and operation of certification marks, or from special legislation enacted for the purpose. The latter approach may be found best suited for developing economies. In India, a special legislation exists, The Indian Standards Institution (Certification Marks) Act, 1952, which empowers ISI to:

(*a*) Establish and publish, in such manner as may be prescribed, the Indian standard in relation to any article or process;

(*b*) Specify a standard mark, to be called the Indian Standard Institution Certification Mark, which shall be of such design and contain such particulars as may be prescribed to represent a particular Indian standard;

(*c*) Grant, renew, suspend or cancel, in such manner as may be prescribed, a licence for the use of the standard mark;

(*d*) Levy such fees for the grant or renewal of any licence as may be prescribed;

(*e*) Make such inspection and take such samples of any material or substance as may be necessary to see

whether any article or process in relation to which the standard mark has been used conforms to the Indian standard, or whether the standard mark has been improperly used in relation to any article or process with or without licence.

Under this legislation ISI has so far issued over 500 licences to some 270 production units. The licences relate to some 160 Indian standards covering as many products. It is estimated that the total annual production under these licenses will reach in the near future the equivalent of some US $475 million.

Under another Indian legislative enactment, agricultural products, including a good many export commodities, are graded and certified. This scheme, known as the "Agmark Grading Scheme", is controlled by the Central Government under authority derived from the Agricultural Produce Grading and Marking Act, 1937. Initial grading and labelling with Agmark labels are done by licensed packers subject to control exercised by marketing officers of the inspection staff of the central and state governments. Official control laboratories maintain continuous supervision over the working of the grading laboratories and test check samples from time to time.

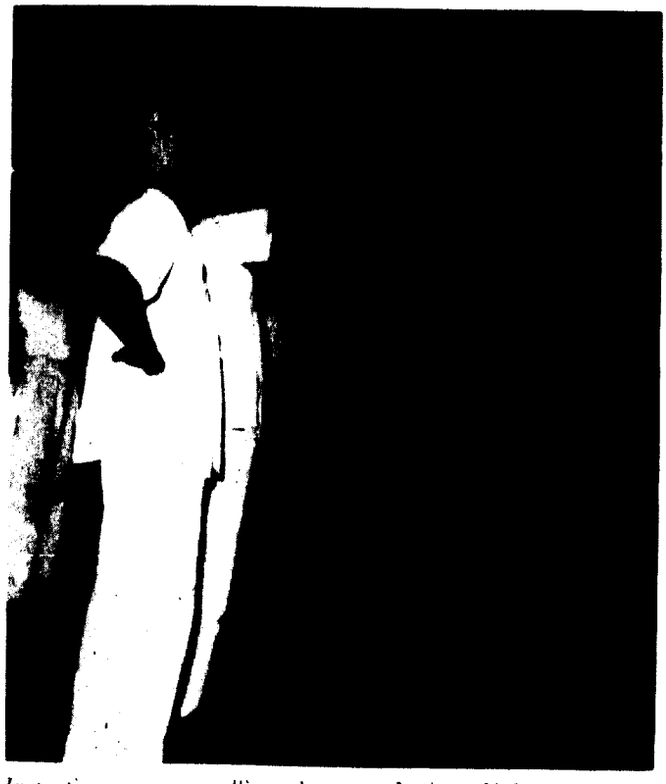
For export commodities, the Central Government has created its own grading facilities. A self-contained inspectorate staff and a chain of laboratories are maintained to carry out inspection of quality before packing. To eliminate any accidental error, a super-check is exercised through testing of check samples and on the spot random examination of various lots.

A total annual production of some US $150 million is already covered under the Agmark scheme. An Agmark or ISI certification mark is also obligatory for certain export goods such as: (i) aluminium utensils; (ii) tea-chests for packing tea; (iii) tobacco; (iv) sandalwood oil; (v) lemon grass oil; (vi) raw wool; (vii) sun hemp; and (viii) bristles.

Consideration is constantly given to bringing other products under similar coverage. Increased demand from overseas purchasers is bound to accelerate this process.

QUALITY CONTROL FOR EXPORT

OBLIGATORY CERTIFICATION MARKING of the export products referred to above is one of a number of measures now being taken in India to promote and stabilize export trade. Of these other measures, pre-shipment inspection schemes for control of quality for export will be of general interest to developing countries.



Inspecting an enamelling plant producing high conductivity annealed round copper wire with a view to ascertaining whether the factory could be licensed for certification marking

Pre-shipment inspection schemes are, of course, not an innovation, but their integration into a comprehensive centralized system for assurance of quality has not been attempted in all countries. Japan is known to have attained conspicuous success in such schemes for rebuilding its export trade after the Second World War. India has taken particular note of the success of these schemes in Japan and, in spite of the differences existing in industrial conditions, much of the system described in the subsequent paragraphs will be found valid for developing countries.

In 1948 the Japanese Government enacted the "Export Inspection Law" which was amended in 1957. Under this law, a number of agencies were established to conduct compulsory pre-shipment inspection of certain commodities designated under the act. A total of 145 important export items has been designated so far, constituting more than 40 per cent of Japan's total export. Export inspection is classified under this arrangement in three categories, namely, (*a*) inspection of quality, (*b*) inspection of packing conditions, and (*c*) inspection of materials and manufacturing processes. The type and extent of inspection applicable to a particular commodity is determined with reference to the nature of the commodity, its end use and other factors. The inspection agencies include six official organs and thirty-nine private organs. Government authorities have the power to inspect their conduct of business and financial conditions at any time. Their business rules, business plans, receipt and expenditure budgets and rules relating to the appointment and dismissal of officers are subject to government sanction. The Japanese act also provides for the setting up of an Export Inspection Council to consider all important matters relating to export inspec-

tion, such as the designation of new commodities for compulsory inspection.

Standards of quality, such as appearance, structure and size of the commodities, as well as methods of inspection, are laid down by the Government. When goods are found to conform to the standards prescribed, they are marked as "passed". In certain cases, the quality standards designate different grades, and marks denoting these grades are applied on the goods.

In respect of certain commodities which are not amenable to inspection on the above-described basis, provision has been made to entrust exporters and manufacturers themselves to indicate that the goods satisfy export specifications by marking them as "export standard". There is provision for spot inspection by government agencies for such goods. Persons exporting any of the specified commodities in violation of the provisions of the law are liable to a fine or imprisonment.

In India, quality control and pre-shipment inspection schemes for certain commodities are provided for by statutory regulations. Many schemes are administered by the Export Promotion Councils for various industries, set up in the past few years to meet the increasingly urgent need of promoting exports for the fulfilment of the national plans. A new ministry known as the Ministry of International Trade has been created in the Central Government to ensure proper planning and direction of all export effort.

Recently, an official committee under the chairmanship of the author was constituted to review the existing facilities for compulsory and voluntary quality control and pre-shipment inspection and recommend policies, methods and further measures necessary to augment trade relations and publicize Indian goods in foreign markets. This committee made, among others, the following recommendations:

(i) There should be prohibition on export of articles intended for human consumption or application as well as those affecting the health and safety of persons, unless they conform to rigid quality standards. Items which fall within this category are drugs, medicines, toilet articles, articles of food, poisonous substances, explosives and such other articles which are prohibited from being imported by consuming countries under their own laws and regulations.

(ii) Where a buyer stipulates certain specifications for goods, provision should be made to prevent the export of articles which are not certified by an inspection agency as conforming to those specifications. This would require official recognition of many private and public sector agencies which are in a position to issue test certificates and survey reports for miscellaneous commodities.

(iii) Goods which are considered important for export markets and for which standard specifications have been or could be laid down should be required to be inspected and certified before export, through appropriate agencies at the time of manufacture or packaging.

(iv) For other commodities where standard specifications may not exist or where it may not be advisable to formulate such specifications, it would be useful to introduce factual inspection for issuing a report regarding the actual condition of the goods so that the overseas importers may be made aware of the nature of the consignment. Factual inspection for goods where standard specifications exist should be discouraged and replaced with compulsory certification.(12)

The committee found that the existing statutory powers were not adequate to enable the Government to institute compulsory quality control and inspection of the type envisaged in the recommendations listed above. Enabling legislation is expected to be introduced in the Indian Parliament in the near future. The committee recommended the formation of an Export Inspection Advisory Council of official and unofficial representatives to advise the Government on related matters and the setting up of a Quality Control Directorate to serve as the executive organ. The Advisory Council has already been formed and the Directorate is functioning in the Ministry of International Trade. There is every expectation that this extension of the standardization movement to promote, extend and stabilize India's export trade on a pattern already tried and proved in Japan, will, if properly adapted, assist the economic development of other developing countries as well.

CONCLUDING REMARKS

THE BRIEF ACCOUNT given in this article of national and international standardization activities has stressed the importance of standardization for the developing countries. A world-wide network already exists, consisting of national standards bodies set up in forty-six countries and the two international agencies ISO and IEC. The rate of growth of standardization over the past fifty to sixty years and its present magnitude provide evidence that the basic concepts and procedures evolved over these decades are sound and that the benefits of standardization are well recognized. Yet further effort should be made to promote standardization in the developing countries.

The planned development of industry in a developing economy will be considerably assisted if, as has been mentioned earlier, standardization is pre-planned or, at any rate, planned at the same time as the development of industry. In planning for standardization, developing countries have the advantage of being able to learn from the accumulated experience of other countries, as reflected in published standards and the recommendations of ISO and IEC. This vast store of concentrated and carefully collated knowledge and experience may be drawn upon by the developing countries to plan their industrial development with the least wastage and utmost expedition. For this, the existence of a national

standards body is a prerequisite, since it is only through such an agency that a developing country can share in the multi-channel flow of information involved in standardization. Assistance to developing countries from outside sources for organizing and strengthening national standards movements will be particularly fruitful.

The United Nations and other organizations are rendering valuable assistance through their technical assistance programmes, but, considering the needs of the developing countries, there is much scope for further efforts in this field, which will not only help the cause of standardization but will at the same time contribute to promoting mutual understanding and co-operation among nations.

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The Inter-American Development Bank and Industrial Development in Latin America

BY JOHN W. DELAPLAINE

THE CREATION AND operation of the Inter-American Development Bank (IDB) is an experiment in regional international banking where member countries control policies and procedures. The purpose of the Bank is to stimulate the economic and social development of its nineteen Latin American member republics. It is concerned with the many problems related to development, such as channelling savings into productive investments, export credit financing of intra-Latin American trade, planning, training, political and financial stability, and in particular promoting economic integration movements in the region.

Real industrial output in Latin America has not had an adequate growth rate in the past five years, and from 1960 to 1962 growth has been disappointing. In real terms, Latin American exports of manufactured goods did not increase from 1950 to 1960. The planning of the industrial sector appears to be weaker than that in the other sectors. The obstacles to growth have already been commented on by many observers. In this article, the writer will try not to catalogue the problems, but will offer comments which appear to be pertinent, yet have in the past received too little emphasis. These comments are based on the writer's experience in industrial projects in Latin America, Asia, Africa and southern Europe, rather than on a statistical or macro-economic study. Published information in the field, including the industrial sector of the development plans, has also been reviewed. The ideas expressed here represent those of the writer and not necessarily those of the IDB.

THE INTER-AMERICAN DEVELOPMENT BANK

Brief history of the IDB

The Inter-American Development Bank officially began operations in October 1960 and by February 1961 had authorized its first loan. The Bank utilizes its ordinary capital resources and its Fund for Special Operations to promote the economic development of its member countries in Latin America. Approximately one-half of the Bank's regular funds is provided by the Latin American member countries and the rest by the United States Government. The available resources of the IDB (ordinary capital plus Fund for Special Operations) are US $550 million, plus callable capital of an additional $431 million.[1] In June 1961, it became Administrator for the $394 million Social Progress Trust Fund, which the Bank holds and administers in trust for the United States Government, to promote the social development of member countries in Latin America. In addition to granting loans from these three resources, the IDB also extends technical assistance in member countries. Operations in the industrial sector involve the use of the ordinary resources of the Bank; technical assistance loans and grants (about $7 million) for economic development planning, training institutions, industrial development banks, and other areas which should be considered as pre-project activities; and the use of resources from the Fund for Special Operations for industrial or development bank loans for those countries having extreme balance of payments difficulties or for projects which do not otherwise qualify for loans from ordinary resources.

It is probable that all IDB loans benefit the industrial sector because they are designed to promote economic and social development and stability. For example, the Social Progress Trust Fund loans, such as those for housing, potable water, and the like, provide increased markets for many industrial goods. One could calculate, using appropriate multipliers, the total benefits to the Latin American national incomes of the IDB loans and other external assistance, and, if one wished, estimate

[1] Callable capital is being increased by US $1.07 billion.

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the direct benefit to the industrial sector. Such an exercise, however, would be of limited value, because of "leakages" or reverse multiplier effects resulting from fall in export prices, political instability, capital flights and loss of foreign investments.

The following table compares the total IDB industrial loans to the total lending operations as of November 1962 (figures in parentheses represent number of loans):

	Amount of loans in millions of United States dollars					
	Ordinary capital		*Fund for Special Operations*		*Total*	
Industrial projects	(21)	47	(1)	1	(22)	48
Development (relending) institutions	(12)	55	(8)	44	(20)	99
TOTAL industrial loans	(33)	102	(9)	45	(42)	147
TOTAL loans from IDB resources	(57)	212	(26)	87	(83)	299[a]

[a] As of 1 July 1963 total was 312.

In addition, 46 Social Progress Trust Fund loans amounting to $271 million have been granted, making a total of 129 loans. Of the IDB money lent from its own funds, only 16 per cent was for direct industrial projects whereas 33 per cent was for lines of credit, primarily for industrial projects, making a total in these two categories of 49 per cent.

Of the 22 direct industrial loans, 5 were made in the capital goods sector (forgings, brakes and drums, chassis, gears, drilling bits, etc., all in Brazil and Argentina), 6 in agricultural processing (fish, meat, flour, citrus and vegetables, crackers, and fats and oils), 4 in the construction materials sector (3 in the cement industry and 1 in prefabricated housing), 4 in paper and pulp, 2 in chemicals and related materials (detergents and chemical specialties, synthetic rubber), one in oil refining and one in textiles (kenaf). With the exception of loans for agricultural processing, all of these projects benefit industries producing intermediate or capital goods rather than consumer goods. Thus, many of these loans provide benefits to production in other industries or sectors of the economy.

The limited amount of direct IDB industrial lending reflects the fact that only a small number of projects are sound from the technical, economic and financial points of view. This comment is not limited to the IDB portfolio of applications but includes what is known of the government and private sector plans in almost all Latin American countries. In the case of Mexico, where the industrial and financial sectors are more active than in other Latin American countries, the Government apparently believes that adequate domestic or foreign financing exists for industrial projects, and therefore IDB activity in the private industrial field in Mexico has been de-emphasized. One is struck by the small number of industrial projects under consideration by the IDB, when its philosophy is to study any sound project which significantly contributes to the economic development of its member countries. The need is apparent for planning specific project developments, improving the investment climate, and broadening markets rapidly by making the integration movements more effective. These should be the joint responsibility of the Latin American countries, their private sectors, and international agencies such as the IDB.

Policies of the IDB

The size of industrial loans that the IDB has made varies from $125,000 to $16 million. In all countries, IDB prefers to establish lines of credit for the smaller loans. As of November 1962, it has loaned about twice as much to development institutions for relending as for direct industrial lending. In general, it will consider loans under $300,000 or $500,000 if no such institution exists. In the larger countries, it may consider a higher limit. Direct industrial loans are currently made at the Bank's interest rate of 5.75 per cent, plus a commitment fee of 0.75 per cent on the undisbursed funds during the construction period. The IDB has found profits to be such that this rate of interest did not work any hardship in any of its projects to date. The period of the loan appears to be more important than the rate of interest. Industrial loans from ordinary capital to date provide for complete repayment within seven to fourteen years and include a period of grace of about one to three years. In determining the period of the loan and grace period, consideration is given to the levels of profits and cash flow, life of the equipment purchased, length of construction period, size of the project, the problems and risks involved in developing markets, foreign competition, price variations, total debt service capacity and balance of payments position of the country. The Bank tries to establish the same conditions for loans of a similar nature but adapts its policies to the needs of the project and the country involved.

The Bank has established certain general restrictions in its industrial loans. In general, it does not engage in refinancing. Thus, it is its policy not to finance expenditures or obligations of the borrower incurred prior to the formal signing of the loan contract. It will not finance working capital, with certain exceptions, such as initial spare parts, catalysts, and chemicals required for the start-up of certain industries. It will not finance projects which will increase the output of materials already in serious over-production in Latin America.

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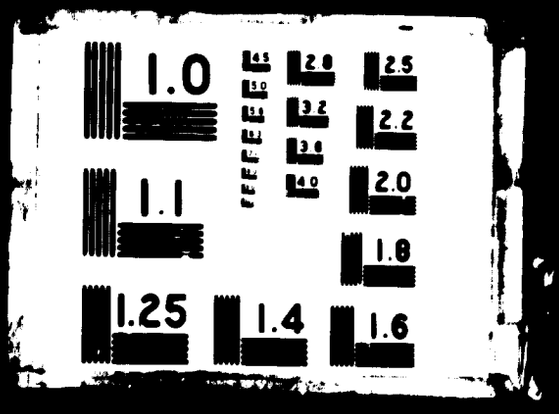

Nor will it finance projects which do not have a reasonable priority in the economic development of the member country. The Bank does not make loans where the borrower does not make a significant contribution to the financing of the project (approximately one-half of the total cost in its direct lending activities). The borrower is permitted to include, as a part of his contribution, the necessary initial working capital and local costs. In several recent cases where equity was lacking, the IDB has studied projects jointly with the International Finance Corporation, the latter providing partial equity either through underwriting, convertible debentures, or other participations (or direct loans), while the IDB provided loan funds. Such a combination furthers the IDB objective of broadening the base of ownership.

The Bank will lend to mixed local and foreign enterprises in all countries. It will consider the financing of wholly owned foreign enterprises in countries where the climate for either local or foreign investment is poor or where the economic benefits resulting from the project are unusually great, but emphasis will be placed on significant local participation. One condition that the IDB includes in loans held by a small group, a family, or a foreign corporation, is that a part of the stock of the enterprise must be offered locally for sale at reasonable prices within a stipulated period of time. This broadens ownership and the capital market, and channels savings into productive investment. A number of projects financed by the IDB contain significant equity contributions both by local groups experienced in starting new projects and foreign firms with the necessary operating experience and "know-how". Such an arrangement appears to be particularly useful in developing new industries within a country. Most of the IDB industrial loans, however, have been to locally owned companies.

Only in special cases does the IDB's charter permit the financing of local currency costs with foreign exchange out of its ordinary capital resources. The IDB prefers to use its hard currencies to finance the import of capital goods, and its local currencies to finance local costs. Repayment is made in the currency lent, the maintenance of value in terms of dollars being required on all private local currency loans. Since its local currency funds are limited, the Bank has had to establish guide-lines as to when it should finance local costs with dollars. It considers such factors as the percentage of the total local costs to be financed in hard currencies, the percentage of foreign exchange cost to total cost, the import component of the locally produced capital goods, the method of local financing of the project, and the economic benefit of the project itself. In certain countries and types of projects, the need for local currency financing is greater than that for foreign exchange. The basic lack of financial resources in both foreign and local currency, coupled with the balance-of-payments problems, require a flexible banking policy.

The IDB follows several policies that extend its resources. United States and European banks have participated in its loans by financing some of the early maturities to the extent of about $7 million. The additional funds for future IDB operations will come from bond issues backed by the callable capital of the IDB and increases in its callable capital. The IDB has floated a $75 million bond issue in the United States and a $25 million bond issue in Italy. It has already made several loans in which supplier credits and loans from European banks were jointly involved. In addition, it requires accelerated loan repayments in those cases where the total dividends exceed 50 per cent of accumulated net profits, the excess of dividends above 50 per cent to be matched by accelerated loan repayment, a requirement which helps to assure the financial success of its projects. Also, it determines a minimum level of working capital (current assets less current liabilities), and of current assets to assure reasonable liquidity of the firm.

Normally the Bank requires that repayment of its loans be guaranteed by a government or a bank, in exceptional cases by a mortgage. The guarantee ensures that the loan will be repaid and the money used for new economic development lending, even in the event of adverse circumstances. However, the best guarantee of a loan is always the basic soundness of the project and the financial and managerial competence and reliability of the borrower.

In its lines-of-credit subloans the Bank's policies are essentially the same as in its direct loans, except that a value is placed above which direct IDB approval of each loan is required. The IDB places considerable reliance on the analyses made by the borrowing institution, and therefore studies only the more essential elements of financial, technical and economic analysis. Most local development banks have made limited contributions to the economic development of the countries. In many cases, the amount of subloans has been discouraging. There have been many institutional problems and a considerable portion of the IDB efforts have been devoted to overcoming these, with encouraging results in some cases. The work of development banks in promoting, analysing and helping in the execution of sound programmes and projects is not easy, and they need the best economists, engineers, financial analysts and administrators available in the country.

Operating procedures of the IDB

IDB's operating procedures for loans are similar to those of other international lending agencies. All applications are screened, and for those where serious study is warranted, a project committee is formed consisting of a loan officer (the head of the committee), a lawyer, an economist, an engineer or architect, and a financial analyst. If, after study, the committee recommendation is favourable, a report is presented to a loan committee and then to the directors for approval. Approval of the loan is followed by a loan contract which must be signed by the Bank and the borrower and which contains the over-all financing plan, conditions prior to the first disbursement, covenants, agreements of mutual un-

dertaking on the project, and a list of goods and services to be financed by the loan. This is followed by letters to the borrower indicating the disbursement procedures to be followed by the IDB, and its requirements for quarterly financial and physical progress reports. Although a considerable amount of work is required in analysing projects and granting loans, this actually represents a minor portion of the total work involved in bringing a project to successful conclusion and repaying the loan. In addition to project and post-project work, the IDB is devoting a good deal of time to pre-project work, technical assistance and economic and industrial development activities, including promotional work on the development of new projects. Its contribution in these fields will be even greater in the future. Its procedures on non-project activities are informal and depend on the type of study being made. Its loans in technical assistance are handled in substantially the same manner as its project loans, as are its loans to development banks and similar institutions.

SOME PROBLEMS OF INDUSTRIAL DEVELOPMENT IN LATIN AMERICA

AS ALREADY STATED, it is not proposed to discuss in this article the major problems of or obstacles to Latin American industrial development, such as monetary and political instability, low absorptive capacity, lack of entrepreneurship, low level of savings, lack of funds for investment, poor investment climate, limited size of markets, and so on.[2] In the following paragraphs, a few comments are made on some problems faced by the IDB which may not have received adequate thought in Latin America, and to the solution of which a significant contribution might be made by those working in the private and international industrial development areas.

Productivity of investment. Insufficient emphasis has often been placed on the production sectors (agriculture and industry) with the result that the productivity of total investment and hence the growth rate of the gross national product have been too low. The considerable emphasis placed so far on social and infrastructure investments should be balanced with recognition of the need for increased output.

Industrial planning. Detailed sector planning, both by the government and private sectors, could stand considerable improvement. More emphasis could be placed, in particular, on costs and prices, comparative advantages, location economics, and intra-regional planning. One cannot be satisfied with the country planning made to date, nor with the more difficult operation of implementation of plans.[3]

Individual projects. As already mentioned, there is a real lack of projects in Latin America today. Financing would appear to be available in most, if not all, countries for any sound and well-prepared project with reasonable financial position (including equity contribution), reasonable capital-output ratio, reasonable foreign exchange savings to initial cost ratio, reasonable production cost, adequate markets and raw materials, reasonable cash generation and reasonable priority in the contribution to the economic development of the area. Financing for the foreign exchange cost of such projects certainly exists. More thought should be given to projects benefiting from the Latin American Free Trade Association (LAFTA) agreement.

Lack of information and knowledge. In many countries, there appears to be a lack of knowledge on the part of both the private and government sectors of what projects could be undertaken and carried out effectively. Private and government sectors are unaware of each other's problems and of those in the various industry sub-sectors. Ignorance of current technology exists, particularly of what is going on in other parts of the world such as Japan, India, Israel, western Europe or even in other Latin American countries. There is a lack of knowledge, for example, of how to use effectively available external funds such as those of IDB, the Agency for International Development (AID), or of how to work effectively with the multiplicity of agencies which now exist. Both the private and public sectors are fearful of the possible adverse effect of free-trade-area competition and have little understanding of comparative prices and competitive advantages. It should be noted, however, that there are some outstanding exceptions as well as several significant new technological developments within Latin America, such as the Mexican HyL direct-reduction process for steel production or the pulping of mixed tropical hardwoods.

High costs. In a number of Latin American countries the government provides considerable protection to promote import-substituting industries even though the prices of the goods produced are extremely high. In one country with a well-developed capital goods industry, the level of prices depresses sales, and it is cheaper to import even with a very high duty, which contributes to aggravating the balance-of-payments deficit. In such cases, the basic problem is one of local sales, not exports. The small size of the present markets is, of course, an important factor in producing these high prices. In addition, inefficiency, poor management and improper equipment often combine to raise their level. At times, high prices are caused by high input costs of—among others—gas or oil, power (in certain areas), steel, transport, labour, money, and government services (taxes),

[2] There are a number of excellent studies on the subject published by the United Nations—in particular, the *World Economic Survey, 1961* (Sales No.: 62.II.C.1)—the Economic Commission for Latin America (ECLA) and the Organization of American States (OAS).

[3] Encouraging work on basic sectoral studies is being carried out in the Industrial Development Division of ECLA and the United Nations Centre for Industrial Development.

and more emphasis should be placed on the reduction of these costs. High prices in certain countries may well inhibit the growth of the common markets, an essential condition for the growth of industry in Latin America.

Dilemmas of industrial development

The difficulties of taking decisions in the field of industrial development, such as assigning priorities to the over-all industrial sector as against other economic sectors, or to specific industrial projects or programmes, and formulating policies to promote industrial growth, are well known. A few of the conflicts inherent in industrial development are listed to illustrate the type of problems encountered.

1. Investment in productive facilities *v.* investments in infrastructure and social overheads;
2. Selectively providing funds for productive investments and working capital with possible inflation *v.* stability but stagnation;
3. Large investment needs but low absorptive capacity, weak planning, poor investment climate and capital flight;
4. More foreign loans *v.* increased debt service and foreign exchange loss;
5. Foreign exchange crisis coupled with export price declines and lack of new export projects;
6. Need for foreign investment, but fear of exploitation, leading to controls;
7. Domestic financing of investments *v.* foreign exchange loss;
8. Growth rate too low to induce investment and more growth;
9. Export *v.* import-substitution *v.* domestic capital goods industries (all are needed);
10. Capital goods *v.* essential or luxury consumer goods;
11. Large government needs for infrastructure *v.* government investments in industry with possible inefficiency and deterioration of investment climate;
12. Project analysis criteria of savings in foreign exchange *v.* value added (solution, "shadow pricing");
13. New industry profit and import tax benefits *v.* decreased government revenues and increased imports;
14. Export and capital goods import revenue taxes *v.* decreased exports and increased project costs;
15. Improved income distribution increasing consumption *v.* decreased savings and reinvestments;
16. Inherent capital intensity of industrial investments *v.* growing unemployment problem in Latin America;
17. Emphasis on labour-intensive project *v.* higher costs and prices (as a rule);
18. Large (monopolistic) plants with low costs *v.* small industry;
19. Large, efficient plants *v.* shortage of equity to finance;
20. Competent established enterprises *v.* inexperienced groups with broad ownership;
21. High protection, costs, prices and profits for reinvestment, but decreased consumption, international competition and retardation of industries consuming product;
22. Traditional private sector industrial planning *v.* need for combined government and private sector planning;
23. Difficulty of industrial planning *v.* priority need to increase output;
24. Desirability and simplicity of macro-economic planning *v.* greater need of projects and sectoral analysis;
25. Development at poles theory *v.* regional backward area planning (solution, establish new poles);
26. Backward area projects *v.* increased costs and comparative disadvantages;
27. Applicability of "shadow pricing" *v.* difficulty of providing money incentives to implement projects;
28. Competition *v.* complementary requirements of integration, and increasing protectionism;
29. Need of loans for a higher percentage of project costs and local costs *v.* increased risks and decreased debt service capacity;
30. Trend towards bilateral approach *v.* need for greater international agency co-operation.

Industrial sector planning

In the planning field in Latin America, there is a lack of detailed "dynamic" analyses of the industrial subsectors emphasizing the key sector-key project approach, production costs and comparative advantages. Too much emphasis cannot be placed on the need for detailed practical pre-project studies. Industrial sector planning requires skills of engineering and economic development, broad and specific knowledge and understanding of technology, production costs, alternate processes and potential and actual raw materials. It requires an ability: (i) to comprehend the essential rather than the details; (ii) to see clearly the principal problems and bottlenecks of each industry and to postulate practical solutions; (iii) to understand and project market trends and prices and to cross-check the results by methods such as those of Chenery;[4] (iv) to work closely with and to aid the private sector, using outside experts when necessary; (v) to establish the objectives of the planning operation, and come up with a realistic investment and growth plan; (vi) to maintain a proper balance between short-range and long-range objectives, as well as between regional and industrial centre needs; (vii) to help formulate appropriate government monetary and fiscal policies necessary to carry out the plan; and (viii) to recommend areas for further work or research.

It is necessary not only to plan but to help to promote specific studies, projects and programmes, and to implement these programmes. Hopefully, the total number of programmes or projects should exceed the number that could be financed, so that there would always be a backlog, enabling foreign or local, private or public capital to finance easily their share. Dynamic sectoral

[4] Chenery, H. B., "The Role of Industrialization in Development Programs", *American Economic Review*, Proceedings (Evanston, Illinois, May 1955), pages 40 to 57.

View of an IDB-assisted plant in Argentina, showing presses for the manufacture of automobile parts

analysis requires taking account of changes with time of material prices, markets, technology, the effect of the growth rate itself, monetary instability, and devaluation. This type of planning facilitates macro-economic analysis. Considerable insight and knowledge can be obtained from a study of growing economies such as those of India, Israel, Japan and Yugoslavia including their methods of sector study, the type of projects promoted, and the way in which the government planning agencies aid their industrial sectors.

There is still a need for macro-economic growth theory analysis, linear programming and shadow pricing, although these appear to be less urgent than sector analysis and project development. Macro-economic analysis made for various target assumptions is particularly valuable in estimating demands, total savings and investment levels, and the need for both local and external financial resources during the planning period. Simple models, based on all sectors of the economy, of the type projected for Israel by Chenery[5] can be used to estimate relative resource requirements of labour, local currency and foreign exchange for various targets and the calculation of their "shadow prices". Based on experience or judgement, one must make arbitrary investment allocation estimates between the productive sectors and the infrastructure, services, and social sectors. There is a minimum percentage or amount of total investment that must go to the productive sectors if appreciable growth is to occur since the capital output ratio is (very approximately) 2 to 4 in the productive sectors and 10 to 20 in the non-productive ones. However, it is difficult to calculate reliable capital output ratios in the non-productive sectors. More work needs to be done on this subject of allocation between the major sectors, and data on the historic growth of the under-developed countries in the post-war years would appear to be essential for this analysis. Another area for further work

[5] Chenery, H. B. and Bruno, M., "Development Alternatives in An Open Economy—The Case of Israel", *Economic Journal* (London), March 1962.

Technician checking pilot-plant and laboratory equipment in the Instituto Mexicano de Investigaciones Tecnológicas, which received a loan from the IDB

might be the integration of the monetary equations into the planning operation. This appears to be particularly important for certain "disequilibrium" economies of Latin America where monetary factors have all too often been disregarded. A third area requiring further work is to improve the practicability of input-output analysis. Two of its interesting uses are: (i) in establishing individual import coefficients to determine the effect of changes in the investment pattern (that is, the effect of a shift to an increased capital goods production) on the balance of payments; and (ii) in "expanded sector" relationships. National income accounting projections are also of value, with emphasis on factor payments (wages, interest, profits, taxes, and so on). Too little attention has been paid to factor payments and yet this is one key to both growth analysis and project criteria.

Project criteria and analysis

There is a multiplicity of criteria for evaluating projects.[6] No attempt has been made to weigh them quantitatively: first, because planning is not sufficiently advanced to establish the proper weights; and second, because such

[6] *See* United Nations, "Evaluation of Projects in Predominantly Private Enterprise Economies—Selected Procedures, Based on Case Studies", *Industrialization and Productivity Bulletin*, No. 5 (Sales No.: 62.II.B.1.).

a small number of economically desirable projects are available that the problem is not one of establishing priorities but of finding "reasonable" projects. From the point of view of the *individual enterprise* one must look at: (i) profitability in terms of total investment, equity, sales, and c.i.f. price of the product, and allowing for adverse events and changes in input prices and markets with time; and (ii) cash flow (profits plus depreciation in relation to debt service) or discounted cash flow. From the point of view of the *economy*, yardsticks should be used not only of value added, or of foreign exchange value added (annual foreign exchange earned or saved less annual foreign exchange cost per unit investment cost or per unit of initial foreign exchange cost), but also of the over-all effect of the project on the economic development of the country or area, that is, the present and future effects on debt service, balance of payments, monetary stability, employment, national income, public finance, income distribution, regional development, social benefits, profits for reinvestment, strengthening of capital markets, maximization of financial contribution of owners, utilization of resources and the multiplier or induced effects of the project on the rest of the economy. The dynamic growth possibilities of the industry in general and the firm in particular should also be considered. Equally important in determining the desirability of a project are the firm's experience record, technical and managerial capabilities, credit worthiness, and ability to finance and carry out the project, and the reliability of the pre-project studies and cost estimates. Thus priorities can be assigned by looking at each project from at least three points of view, the entrepreneurial, the social-economic, and the banking. Unless a project is carried out and placed in successful operation, unless it provides a significant contribution to the development of the area, and unless it provides a profit for its owners (or some significant benefit in the case of a government-owned project), then it should not be undertaken.

The shadow pricing technique goes part way towards resolving the inherent conflict between: (i) on the one hand, production theory or micro-economic analysis with its concepts of equilibrium analysis, the theory of the firm and profit, and its emphasis on comparative advantage, opportunity costs, and resource allocation; and (ii) on the other hand, growth theory combined with dynamic and macro-economic analysis where factor prices are not equal to opportunity costs or to actual prices at the moment, but depend on longer-run relative scarcities. "Social" value added by manufacture per unit of money invested, including both direct and indirect benefits, appears to be the best criterion developed to date, if adequate allowance can be made for the appropriate shadow prices of foreign exchange and labour. But this, or the even simpler criterion of value added, is difficult to use because: (i) indirect benefits, backward and forward linkages, and multiplier effects are difficult to evaluate and even the effect of induced investment depends on whether the country is short of projects or short of money; (ii) some arbitrary method of discounting must be adopted in order to compare future with immediate benefits to the gross national product or the balance of payments; (iii) positive direct benefits may be more than offset by negative indirect effects such as political and monetary instability, regional unemployment due to failure of a competing industry, inflation, and other causes, or *vice versa*; and (iv) reliable data for establishing shadow prices are not available. In addition, so little is known about the application of the basic macro-economic equations that it is not obvious whether the increase in gross national product is greatest if one tries to maximize disposable personal income, investment, total consumption, wages, or profits for reinvestment.

Project analysis involves the evaluation of projects or programmes using the criteria just discussed or similar ones, and includes technical, economic, financial, legal, and perhaps social analyses. Often these cannot be separated. For this reason, joint analyses by persons of different disciplines appear to give better results than isolated studies. The emphasis in the IDB is on dynamic analysis in an effort to evaluate properly future events such as the effect of future competition, devaluation and inflation, changes in selling prices (often a very important variable), input prices, sales volume, construction costs (particularly local cost increases due to inflation), and start-up difficulties. In addition to the usual evaluation of technical, financial and economic soundness, considerable importance is placed on cash flow analysis, unit-production cost analysis, comparison with c.i.f. prices, comparative advantages, the foreign exchange savings analysis, and on the economic benefits of the project to the area.

Other tools often used by the IDB in its analyses are: (i) break-even point analysis; (ii) minimum and optimum plant size calculation; (iii) location theory calculations; (iv) calculations based on several assumptions of devaluation and inflation; (v) cross-checks of market analyses by independent methods; (vi) detailed study of effects of competition within the free-trade area, and from countries outside the area; (vii) study of export possibilities, particularly to other Latin American countries; and (viii) study of use of domestic raw or intermediate materials from other Latin American countries in the framework of regional integration.

In order to make a study of the type indicated above, the IDB has adopted the philosophy that it should try to know as much as possible about technology, production costs and markets in the important industries and commodities in Latin America and in other countries of the world. If the IDB is as well or better informed than its private borrowers, project analysis is simplified and a contribution can sometimes be made to the successful completion of its projects. It must keep abreast of important technological innovations, to learn what is going on industrially, and to understand the industrial problems and bottlenecks in each of its member countries.

REVIEW OF IDB DIRECT INDUSTRIAL LOANS

Pulp and paper

In its direct lending, IDB's greatest contribution to industrial growth is probably in the pulp and paper field. In the four IDB loans made to date, the total annual foreign exchange savings should be of about $35 million and the total contribution to the gross national product of about $37 million, the total foreign exchange costs of the projects being $35 million and the total cost $73 million. The large amount of activity in the pulp and paper industry is due in part to the dynamism of the private sector in this field in several countries, but much of the credit should be given to the excellent work of the ECLA-UN-FAO office in Santiago, "Grupo Asesor en Papel y Celulosa", and its studies of the regional needs for paper in Latin America. Even though the Latin American operating companies have had considerable experience in the field, foreign consultants with the latest information on technological improvements were used to advantage on all four of the paper and pulp projects.

All four projects involve large and significant expansions in pulp capacity in the respective countries, at low production costs, the latter being an element of particular importance. Value added and foreign exchange savings ratios are high. Three of the projects involved integrated pulp and paper operation, which appreciably reduces all unit costs, particularly pulp costs, as a result of higher profits on the paper products, the profit margin for which is considerably higher than on pulp in Latin America. Two of the projects involved new Latin American process developments in the field of mixed tropical hardwood pulping, which have potential application in less developed countries in other parts of the world. One project involved almost entirely the export of long-fibre sulfate pulp to other Latin American countries within the LAFTA market, and benefits will be achieved both in the exporting and importing countries. The project also illustrates the advantage of long-range planning in raw materials. One project involved backward integration from paper by adding a small pulp plant to prove out the new process, and using already existing utilities and services. Particular attention should be paid to the approach of the investors who built up the industry on a sound stepwise approach, thus permitting more reasonable selling prices than if a single large investment had been made. The same company has a high growth rate of sales of its containers and cartons because of its rather outstanding departments of design and customer sales and its ability to aid its customers in the packaging field. The project is an excellent example of a joint United States-Latin American undertaking. In addition, the initial work on development of the new pulp process was carried out by the government development institution so that this phase of the project is now equally owned by all three groups, again an excellent example of a co-operative venture.

Capital goods industries

The IDB has financed several projects in Argentina and Brazil in the capital goods field, particularly in automobile parts such as brakes and drums, gears and chassis. These projects are reasonable ones, but it is not at all certain that they are really significant in regard to the over-all needs of these sectors in Brazil and Argentina. In this sector, both countries are faced with the problem of low sales, high costs, high protection, and loss of foreign exchange because imports are cheaper. An excellent start has been made by ECLA and several governments on sectoral studies of the capital goods industry in these countries. More work needs to be done in this important sector in establishing the real needs, bottlenecks, cost prices and priorities. Certainly this is one of the most important sectors for Latin America's future growth, particularly because of the shortage of foreign exchange and the high level of capital goods imports (over 45 per cent of total Latin American imports).

Agricultural processing

The IDB has financed one large citrus and vegetable processing project even though no reliable market study was available. The project was justified, however, by the dynamic growth possibilities of the local and export markets. At a selling price equivalent to the c.i.f. price, the break-even point was less than 25 per cent of the normal operating capacity of the plant. Thus a small market was needed to justify the project. The potential market also justified the inclusion in the project of a large vacuum-flash-drying unit for producing completely dehydrated citrus products. Many other products such as vegetables, tea and milk might eventually be processed by using this equipment. Another large project was for

View of a plant set up in Paraguay with IDB assistance, for processing oils, cotton and tobacco. The solvent extraction unit may be seen in the centre

a tuna fish processing plant with fish meal and oil as a minor phase of the project. This was essentially an export project and market studies were difficult. The technique used was to establish high, low and medium selling prices and costs to assure that the project was economical even under the most pessimistic assumptions. This project is being carried out by the government in order to develop a new industry, and it will be offered for sale to the private sector when placed in successful operation. The government has also carried out an integrated fishing port development programme to further the development of this industry. Several other projects have been financed in the agricultural processing field such as corn flour, bakery products, meat processing, textiles and fats and oils. In several cases there was a problem of growing adequate quantities of raw materials and in developing markets for the products. Perhaps the greatest economic benefit was achieved in the fats and oils processing field. The one small textile loan represented a backwards integration into the processing of kenaf and other fibres. As the ECLA studies show, the rehabilitation and rationalization needs of the Latin American textile industry are great.

Petroleum, chemicals and petrochemicals

One petroleum refinery and two chemical projects have been financed—synthetic detergents and synthetic rubber. In the latter one, the main problem was in establishing the real comparative advantage of the processes, especially in view of potential competition within the two common market areas. In one case the borrower, a government enterprise, associated itself with a recent and outstanding development of polybutadiene production in the United States that promises a product superior to those currently on the market. In the other, a new sulfur trioxide sulfonation process was employed. The loan to a government oil refinery involved primarily the upgrading of by-products. A number of additional projects that the IDB has been following closely in the chemical field will probably be submitted for its future study. Here again, the ECLA studies have been useful. The chemical industry is a field where common market agreements are particularly important since the minimum economic plant sizes are large and investment costs are high, as are existing production costs and selling prices. Latin American countries have the natural resources available to produce their chemical requirements at low cost. Further efforts to lower tariffs rapidly within the LAFTA area would appear to be desirable. In addition, markets for fertilizers, insecticides, weed killers and agricultural chemicals need to be developed through subsidies, tariff reductions, education, demonstration projects and other types of government aid.

Construction industry

The IDB loans in the construction industry complement IDB's extensive work with its Social Progress Trust Funds in housing loans. One loan went for a plant to produce prefabricated houses using a French technique in a country where interest rates were 2 to 4 per cent monthly. The project could be justified in the saving of construction interest on houses alone. In the construction industry, however, far more work needs to be done on establishing housing standards and in planning. Three cement plants have been financed, one of which is government-owned. The cement industry is well established in almost all countries and can usually provide its own sources of financing for expansion, except in the marginal geographic areas. The IDB financed one cement project in the only Latin American republic which lacked such a plant. Efforts had been under way for many years to build the plant in the country, and the need for the project was obvious.

THE LATIN AMERICAN FREE TRADE ASSOCIATION AND INDUSTRIAL DEVELOPMENT

THE YEAR 1962 appears to have been a year of serious economic deterioration in Latin America, characterized by a large loss of foreign exchange, a flight of capital, an appreciable decline in both foreign and total investment, a slow-down of the growth rate of national product, increase in unemployment, and political and monetary instability. For the seven large countries (Argentina, Brazil, Colombia, Chile, Mexico, Peru and Venezuela) total foreign debt exceeds $6 billion, annual debt service exceeds $1.2 billion or 20 per cent of total imports, and investment income sent abroad annually exceeds $1 billion. Faced with a decrease in rate of import substitution, foreign investment, and foreign loans, Latin America must reverse these trends and increase significantly its intra-zone trade.

There are two schools of thought on the direction that Latin America can take, the autarkical or self-sufficiency school and the integrationist school advocating free trade within the zone. The present LAFTA agreement represents a compromise between these schools but tends to favour the former with its five basic concepts: (i) emphasis on *gradual* trade liberalization on those items *now traded* within the zone; (ii) bilateral or multilateral treaties of complementarity for those items not traded; (iii) special tariff protection in under-developed countries for limited periods, particularly to aid the establishment of new industries; (iv) special protection for agriculture, and (v) escape clauses for industry or for countries undergoing balance-of-payments difficulties. The three latter concepts appear to be essential. To date, some progress has been made on trade liberalization, and one treaty of complementarity has been signed. But

Installing cement manufacturing machinery in a Peruvian plant built with IDB assistance

View of an IDB-financed plant built in Uruguay for manufacture of cement and utilization of oil refinery by products

the available evidence suggests that there is no alternative to extensive tariff reductions within the LAFTA area in manufactured goods, particularly in the dynamic growth industries. Economic integration in Latin America appears to be inevitable; the sooner this occurs, the sooner can Latin America regain stability with an adequate growth rate. The economic and monetary conditions may well deteriorate further. It could probably be demonstrated that no tariffs reductions (if employed with adequate safeguards) would harm any country to the extent that enforced stabilization has hurt Argentina and its industry in 1962, or to the extent that recent unprecedented inflations and devaluations have affected a number of countries.

The IDB places particular emphasis on the expansion of Latin American integration movements and the solution of their problems. The present foreign exchange crisis presents no practicable alternative. The IDB made one $16 million loan for a project whose product would be almost entirely for export to other LAFTA countries. This one loan will increase intra-LAFTA trade directly by about $17 million. Since the total intra-LAFTA exports of manufactured goods (all consumer durables, intermediate products, and capital goods) amounted to about $42 million in 1960, this represents an increase of over 40 per cent. Manufactured goods in these categories represent about 70 per cent of total LAFTA imports, which is a major drain on the limited foreign exchange earnings. In the viewpoint of the writer, the creation of an effective low-tariff Latin American free-trade area might do more towards solving the basic problems than any other single activity. It would also do more towards furthering both industrial and economic development in the Latin American countries and in creating a spirit of effective co-operation.

Let us examine the potential benefits and the problems to be encountered if most tariffs on manufactured goods are eliminated or appreciably reduced. A study on exports and imports in 1960 of seven Latin American countries and their mutual trade (Argentina, Brazil, Chile, Colombia, Mexico, Peru, Venezuela) can be summarized as follows:

	(Millions of United States dollars)		(Percentage of total)
	Total	Mutual trade	Mutual trade
Exports	6,930	612	9
Imports	5,915	560	9
Exports of capital goods, intermediate products and consumer durables	731	46	6
Same, excluding copper and copper products	215	44	20
Imports of capital goods, intermediate products and consumer durables	4,185	52	1.2

Thus, there is a gap of about $4 billion of capital goods, intermediate products and consumer durables, representing a large potential foreign exchange saving if Latin America could import from itself rather than from outside the zone. If all these materials were produced within the zone, the present output of the total manufacturing sector of these countries could be increased by almost one-third from its present level of $12.7 billion, even with no allowance for growth. In the capital goods field alone, it is estimated that Latin America now produces only 10 per cent of its needs.

It is not practical to replace all of these $4 billion of imports, but a 25 per cent or even a 10 per cent replacement ($400 million) by intra-zone trade, plus the accompanying benefits such as greater foreign investment, would go a long way towards solving the basic foreign exchange problem of Latin America, and possibly permit it to: (i) achieve monetary stability; (ii) arrest capital flight; (iii) regain a high level of foreign and local industrial investment; and (iv) achieve an adequate growth rate. In addition, a large reduction or elimination of tariffs in intra-zone trade would permit plant location on the basis of comparative advantage and both foreign and local investment climate. Future plant sizes would undoubtedly be larger and costs lower, total investment would increase, the idle capacity that now exists in the capital goods industries could be utilized and specialization would occur, providing competition plus some degree of complementarity. The high level of current

prices in capital goods, intermediate goods and consumer durables would be reduced through competition. The process of intra-zone trade expansion could be aided considerably by the export-financing scheme now being developed by the IDB. However, tariff benefits will be needed to make this scheme truly productive, since Latin American manufactured products are in general not competitive now on a price basis with United States, Japanese and European exports, particularly in the capital goods and consumer durables fields.

In order to minimize harmful effects of extensive tariff reductions, escape clauses might have to be broadened to include such concepts as voluntary restrictions on exports where excessive harm occurs, and concentrated effort by governments with positive zone trade balance to increase zone imports. The under-developed countries would still require special tariff concessions, and the five Central American countries might wish to enter LAFTA as a bloc. The Central American integration movement has clearly demonstrated the advantages of extensive tariff reductions.

In order to convince countries that the idea of a true free-trade area is acceptable, it may be necessary to make several specific regional studies involving detailed analysis of each country and each major sector of industry. The studies would involve data on imports, exports, production and idle capacity (exportable surplus) and costs, prices, minimum economic plant size, comparative advantage, and so on. Emphasis would have to be placed, not only on which items could be added to the negotiation lists, but also on which items or industries could not be placed on the free-trade lists, and the amount of protection needed for the latter items. An excellent start has been made for one industry in the ECLA study of the chemical industry.[7]

[7] ECLA, "La Industria Química en América Latina", vol. I and II (E/CN.12/628, November 1962).

SUMMARY

THE IDB BELIEVES that it has made a contribution in the industrial field, particularly in the private sector, in its first two years of operation. This article has suggested that there is a need for more detailed sectoral planning and the development of specific projects. There is a further need for better understanding of the industrial problems in Latin America, and more co-operation between the private sectors, the government sectors, the various international agencies, and foreign governments and private groups, as well as better co-operation within each of the groups. None of these groups should really be satisfied with their efforts to date, efforts which are often so dispersed that little progress is made towards the solution of the significant problems. In the industrial development area, the international agencies need to work more with each other and with the various governments and private sectors to define exactly what these significant problems are and what are their potential solutions. It is not enough to talk about the lack of projects or absorptive capacity or investment climate or the presence of structural disequilibrium and monetary instability, but positive solutions must be found. There should be more work of the type sponsored by the ECLA Industrial Development Division and the United Nations Centre for Industrial Development. Yet studies, however helpful, should be followed up with concrete projects. One of the areas where the international institutions might concentrate even more is in the development of significant projects. Particular emphasis might be placed on projects with high direct plus indirect foreign exchange savings (or earnings) ratios per unit of investment cost, because the foreign exchange crisis (and the accompanying effects) is perhaps the major economic problem today in Latin America.

Considerable work is needed in many areas other than planning, project development, and economic integration. Ways should be found to improve the contribution of the local development banks and perhaps the planning agencies in the various countries. Realistic attitudes and improved and uniform incentives are needed for both foreign and local investment, particularly in the area of joint enterprises. There are obviously problem areas of export financing, local cost financing, financing of local sales, taxation, high prices, investment guarantees, monetary stability and inflation, lack of growth, and many others. These must be studied and effective solutions determined. Obviously, the IDB and the other international institutions can help resolve only some of these problems. The IDB believes that it must make a far greater contribution in the next five to ten years, if dynamic growth in Latin America is to be achieved.

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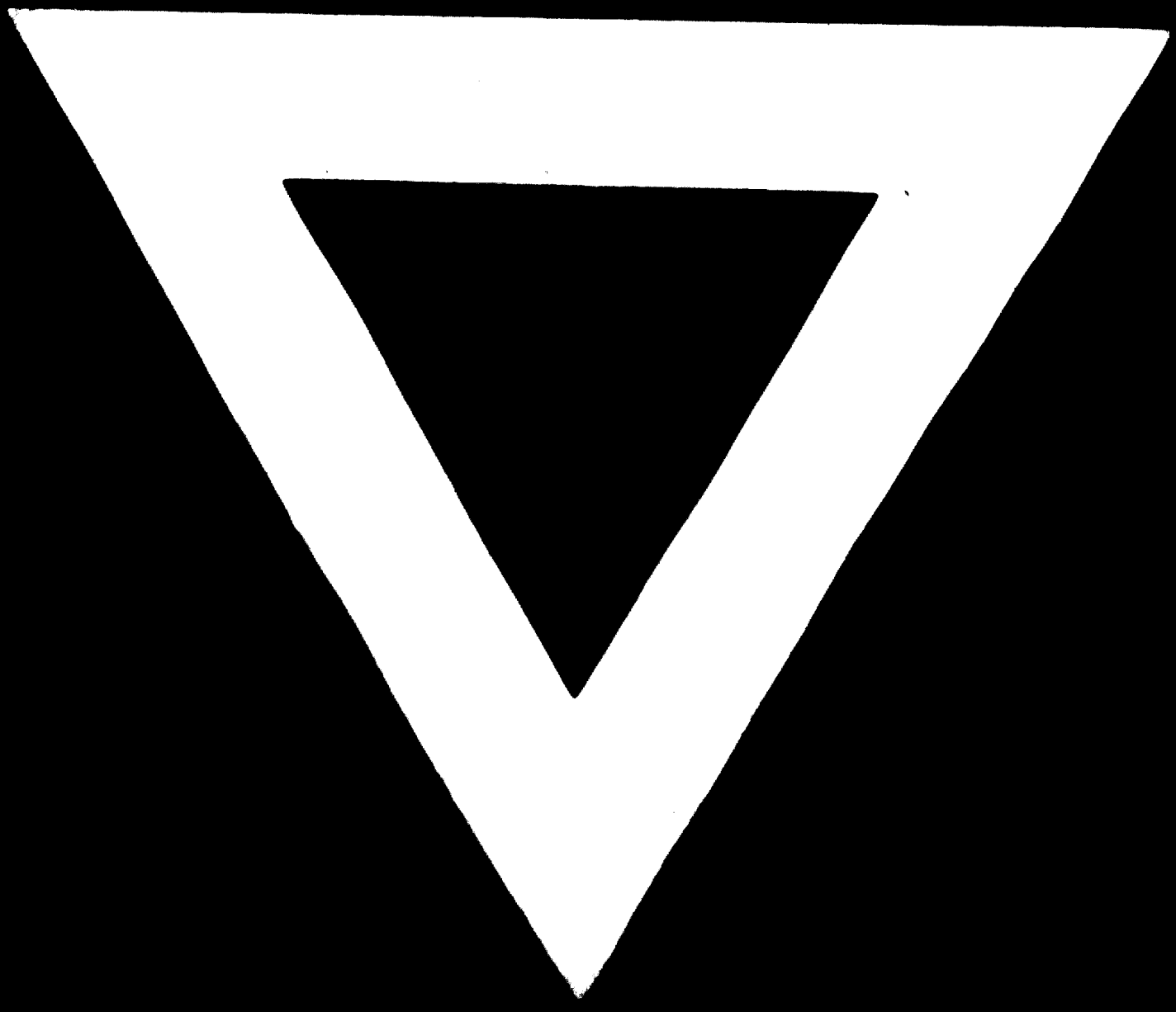

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