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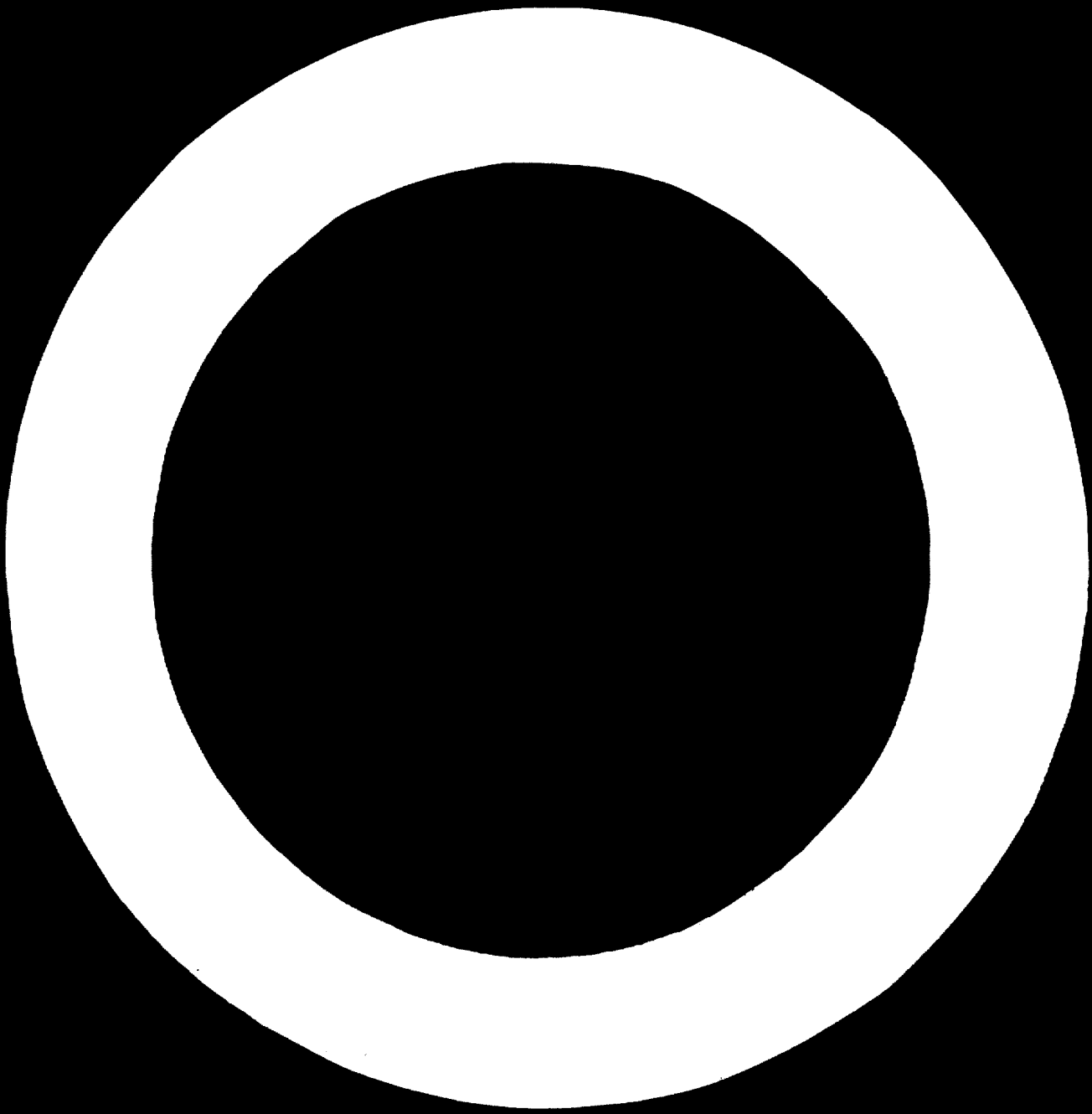

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Skill Requirements in Manufacturing Industries

By MANUEL ZYMELMAN

For almost all developing nations industrialization implies a sharp break with the past. Certain established trends may continue, but the major thrust of industrialization involves a new direction in the forward movement of the various economic sectors. Even where past experience could be of assistance in the construction of plans for the future, in most cases the statistics would be insufficient to compute an accurate trend. As a consequence economic plans are too frequently constructed with little or no statistical basis and without adequate provision for establishing such a basis.

If relatively rapid progress is to be made in carrying out an industrialization programme, however, a minimum of statistically related planning must take place. This is clearly recognized by most developing nations and reflected in their preparation of general economic plans to assist in their industrialization. While many of these plans take manpower into account, too few economic planners consider human resources as a major factor in the development process. Only in recent years has increased emphasis been placed on this factor and knowledge of it is still rather limited. Clearly, however, the human resources factor must be fitted into any general economic plan. The projection of future manpower requirements within the framework of a general economic plan requires that projected industrial output be related to the manpower required to produce that level of output.

When an industry or economic sector already exists, one alternative is to project the future manpower requirements of the whole industry from the occupational structure of its most modern plants. India, for example has used this procedure in its development plans for several industries. For many other industries, however, this procedure was apparently not considered appropriate and was not used. Other nations have undoubtedly used this approach in estimating future manpower requirements for expanding sectors of their economies.

Another alternative open to all developing nations, as well as to fully developed nations, is to use the quantitative data from other nations as a guide. This approach was used by the planning and developing agencies of Puerto Rico in its "operation bootstrap". In Puerto Rico it was assumed that the major sectors of the economy in 1975 would approximate the productivity levels of the United States in 1950, with the distribution of employment following a similar pattern. Perhaps data from other nations would have been more appropriate but as no reasonably comparable statistics were available, there was no alternative. Despite the disparate levels of economic development between Puerto Rican and United States industries, the comparisons were used with considerable success.

Although few experts in the field of manpower and human resources development fail to recognize international comparisons as a basic method of making manpower projections, the use of such comparisons has been limited because the relevant data have not been collected, analysed and made available to the developing nations of the world. Recommendation of the international comparison method of manpower projections as a valuable approach is inevitably footnoted with the *caveat* that the necessary data are not available.

In this current report, preliminary statistics on manpower of selected countries at different levels of economic development are presented. It is assumed that data for countries at different levels of economic development

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represent different levels of technology, broadly defined to include such factors as establishment. For such an array of data, presented by industry or economic sector, a developing nation can select a set of statistics as its target for some future level of development. The greater the number of countries included, the greater the likelihood that a developing nation can find the set that most closely matches its purposed level of development. While it is possible to interpolate between sets of data, steps between relevant sets should be kept as narrow as possible in order to minimize errors.

This approach of manpower projections is based on the hypothesis that a given skill composition reflects a given state of technology (and hence productivity). A *direct* relationship between value added per employed person in a given industry and the skill composition of the work force in the same industry is then to be expected. This hypothesis was tested by the use of statistics from various states of the United States. There are adequate grounds for assuming that the relationship exists and while it has not yet been tested on an international level, there are indications that it will also be valid in this field.

In summary, the basic underlying assumptions of this study are: (*a*) that planned rapid economic growth for any developing nation involves a rather sharp break with its historical past; (*b*) that international comparison of occupational structures is a basic method of making manpower projections; and (*c*) that the link between manpower planning and the planning of production is the relationship between the skill composition of the labour force in a given industry and the productivity of the industry.

Skills and Productivity

The planning of an industrial sector requires considerable understanding of the way in which inputs are transformed to the desired outputs. In economic theory this transformation is represented by a production function showing the outputs which can be obtained from various combinations of inputs, assuming a given state of knowledge. Most production functions in economic literature concentrate upon the combinations of capital and labour; hence the substitution of capital for labour and *vice versa*. Little attention is paid to the type of labour that must be combined with a given type of capital. Production functions deal with relative quantities rather than with qualities of factors.

The focusing of attention on the type rather than on the relative amount of labour is of recent date. This reorientation was brought about on the one hand by the apparent increase in structural unemployment in highly developed economies and by the growing awareness of the investment characteristic of education, and on the other hand by the inability of some developing economies because of a lack of skills, to achieve the desired levels of productivity, regardless of the amount of capital they employed.

Solutions to the problems of unemployment and low productivity are hampered both by the failure of economic theory formally to incorporate labour as a homogeneous input, and by the paucity of research into the work force composition of different industries and its relationship to productivity.[1] There is reason to believe that a high degree of complementarity exists between a certain type of production method and the kind of labour force needed for it. In other words, a certain level of technology (and hence, a certain level of productivity) is represented by a specific kind of organization and by a specific kind of capital equipment that is made to work by a labour force whose occupational composition is well defined. This assumption can be formalized as follows: The productivity of an industry is linked to a specific occupational distribution of its labour force. The production function in this case is of the type

$$O \quad F_1(K, L_1, L_2, \ldots\ldots L_n) \qquad (1)$$

where: O is output; $L_1, L_2, \ldots\ldots L_n$ are the number of workers in occupations $1, 2, \ldots\ldots n$; and K is the amount and type of capital.

We can rewrite (1) in the following way:

$$O\,L \quad F_2(K/L, L_1/L, L_2/L, \ldots\ldots L_n/L) \qquad (2)$$

where L is the total number of workers. Furthermore, if it is also assumed that K/L is a function of the occupational distribution of L, then it follows that:

$$O\,L \quad F_3(L_1/L, L_2/L, \ldots\ldots L_n/L). \qquad (3)$$

State data of the United States were used to test this formulation. Industry occupational data came from the 1960 United States *Census of Population* and the industry productivity data were derived from the 1960 *Annual Survey of Manufactures*. The former provides the occupational composition of industries in each of the fifty states; the latter, value added and number of employees by industry. State data were used because of their comparability and the adequacy of the number of observations. Occupations and occupational groups were selected on the basis of distinctive job functions. For example, in the professional and technical category, separate data were presented on accountants, engineers, scientists and technicians. In the manual worker category, operatives and craftsmen were distinguished; and in the craftsmen category, mechanics, electricians, foremen, etc. The nineteen occupations or occupational groups used in the multiple correlation of state data are: (1) accountants and auditors; (2) chemists and natural scientists; (3) engineers and architects; (4) technicians; (5) other professionals; (6) managers, officials, proprietors; (7) clerical and kindred workers; (8) sales workers; (9) blacksmiths, boiler makers, millwrights, tinsmiths; (10) machinists; (11) electricians; (12) plumbers; (13) mechanics and repairmen; (14) foremen, n.e.c.; (15) cabinet makers and carpenters; (16) craftsmen, n.e.c.; (17) tool and die makers; (18) operatives; (19) labourers. The

[1] We shall assume that productivity is the output per unit of a factor of production. Since we are dealing mainly with the input of labour, we shall refer in the future to the productivity of labour simply as productivity.

percentage of these nineteen occupations or groups in the work forces of each industry in each state constituted the occupational composition of each industry by state. A multiple correlation across states for each industry between value added per employee and occupational composition gave the following coefficients of determinations:

Table 1

CORRELATION BETWEEN PRODUCTIVITY AND OCCUPATIONAL DISTRIBUTION IN SELECTED INDUSTRIES IN THE UNITED STATES—1960[a]

Industry	*Linear correlation*		*Linear correlation, log-form*	
	Correlation coefficient	*Coefficient of determination*	*Correlation coefficient*	*Coefficient of determination*
Foods and beverages	0·878	0·768	0·775	0·601
Textiles	0·687	0·472	0·854	0·730
Apparel and other fabricated textiles	0·784	0·614	0·829	0·688
Printing and publishing	0·754	0·569	0·785	0·617
Rubber and plastics	0·677	0·458	0·807	0·651
Chemicals	0·789	0·623	0·940	0·883
Fabricated metals	0·766	0·586	0·820	0·672
Machinery, excluding electrical	0·806	0·649	0·820	0·672
Electrical machinery	0·741	0·549	0·694	0·482

[a] All coefficients of correlation are significant at the 5 per cent level. The coefficients of column (1) were obtained from a linear correlation of the type $y = a + a_1x_1 + a_2x_2 + \ldots a_{19}x_{19}$, where y is value added per employee, x_1 the percentage of occupation 1 in the total work force, x_2 the percentage of occupation 2, and so on. The coefficients of column (2) were obtained from a linear correlation of the type $\log y = a + a_1 \log a_1 + a_2 \log x_2 + \ldots + a_{19} \log x_{19}$, where y, x_1, x_2 and so on, are the same as in the first equation.

These correlations show a relationship between value added per worker and the occupational mix of a given industry. It must be stressed, however, that the nature of the relationship is not the same for each industry. Each industry seems to have its own pattern of occupational change as productivity changes, and we cannot generalize from one industry to another. Table 2 gives an idea of the direction in which the percentage distribution of selected occupations in the work force of each industry changes as the industry's productivity varies. This table shows substantial differences between industries. In textiles, for example, operatives trace a clear trend. As productivity increases, the

Table 2

OCCUPATIONAL PATTERN VS. PRODUCTIVITY IN SELECTED INDUSTRIES IN THE UNITED STATES—1960

Occupations	*Industries*								
	Food and kindred products	*Publishing and allied industries*	*Rubber and plastics*	*Chemicals*	*Machinery (excl. electrical)*	*Textile products*	*Electrical machinery equipment*	*Fabricated metal industries*	*Apparel and others*
Accountants	↗	↗	↗	↗	↗	→	↗	↗	→
Chemists and physicists	↗			↗		→			
Engineers	→			↗	→	↗		↗	↗
Technicians	→	→		→	↗	→		↘	↗
Other professionals	→				→	→		→	→
Managers			↘		↘	→	↘	↘	→
Clerical workers	→	→	↘		↗	→		↘	→
Sales workers	↘	↘	→			→	↘		→
Machinists	↗	→			↘		↘		
Electricians	→	→	↗		↗	↘			
Mechanics					↘		↗		
Foremen			↘	↗		→	↗		↘
Operatives	↘	→				↘	↗		↘
Labourers			↗			↘	↗	↗	

Note: A line from the lower left to the upper right-hand corner means that the proportion of this occupation in the total work force rises as productivity rises; from the upper left to the lower right-hand corner, that the proportion of this occupation in the total work force falls as productivity rises. A solid line indicates a strong relationship; a dotted line, a weak relationship; an empty space, no relationship.

proportion of operators in the total work force decreases. In contrast, in printing, publishing and allied industries, the number of operatives increases as productivity increases. In fabricated metals, the proportion of managers decreases as productivity increases but in textiles and in apparel, the opposite occurs. In a number of cases, there is neither a clear relationship between specific occupations and productivity nor, in general, an indication that an increase in productivity is accompanied by a uniform change in the occupational composition of each industry. This analysis is confined, of course, to a certain minimum productivity range.[2]

It is possible that the same relationships between productivity and occupational mix are valid for productivities well below (or above) those of United States industries. As shown below, we have reason to believe that these relationships do change when considering broad ranges of productivity.[3] However, the most important lesson to be learned from these data is that a systematic relationship exists between occupational mix and productivity, but that each industry has its unique pattern. The idea that the productivity of an industry is reflected in the occupational composition of its labour force can be applied to international data. The spectrum of international productivity levels is much wider, and we can therefore expect clearer trends and more discernible patterns. However, the difficulties involved in using international data are considerably greater than those involved in using United States data. A major difficulty is the lack of comparable systems for classifying and reporting occupations.

Problems of occupational classification — extension of the argument to international data

A minimum requirement of international occupational data is that it should permit interindustry and intercountry comparisons of key occupations because these occupations represent skills crucial for development and are intimately linked to technological change. Occupational data thus have to be sufficiently detailed to show well-defined jobs; these jobs can then be grouped into classifications of closely related jobs having the same level of skill and requiring the same types and amounts of education and training. Furthermore, for purposes of international comparison, job groupings in different countries ought to include the same types of work. Such comparability however, is more than a matter of job title; it also involves job content.

Population censuses are the source of most of the currently available occupational data. To varying degrees all census data seem more concerned with reporting traditional job titles, regardless of their significance to the economy, than with reporting jobs (especially new ones) essential for growth, or with determining whether the title fits the content of the job. For example, at least one major European country seems more interested in knowing the number of its barkeepers than in knowing the number of its technicians of various types. Different types of technicians are frequently grouped under one all-inclusive label, irrespective of what they actually do.

For the researcher, international occupational data present three interrelated problems, aside from the question of accuracy, which we assume solved for this discussion. The first problem, and conceptually the least serious of the three, is excessive aggregation, compounded by a failure to use similar groupings of data. Dissimilar groupings reflect in part differences in the degree of aggregation; in part, different combinations of occupations at the same level of aggregation. No country presents such detailed data as that provided by the five-digit occupational titles of the *International Standard Classification of Occupations* (ISCO).[4] Most countries use either the ISCO's three-digit unit groups, its two-digit minor groups, or some variation of one or the other. An example of a five-digit ISCO occupation would be "Machine-Tool Setter, Metal Working", which is a part of the three-digit unit group, "Fitter-Machinists, Toolmakers and Machine-Tool Setters", which in turn is a part of the two-digit minor group, "Toolmakers, Machinists, Plumbers, Welders, Platers and Related Workers".[5] Any aggregation below the three-digit level is relatively useless if one is interested in precise occupational comparisons. Unfortunately, once the data have been combined in dissimilar ways it is impossible to make valid international comparisons unless one could decompose the figures, a procedure precluded by the failure to set out occupational data in finer detail.

Aggregation presents another problem as well. It conceals what might be significant trends or vital jobs in an occupational structure by submerging them in a broad grouping. Broad groupings are particularly deceptive if they contain offsetting trends. Work with United States occupational data by industries and states, for example, suggests that certain specific occupations such as accountancy or mechanical engineering might be more important in distinguishing different sectors of an industry than a more inclusive group, such as one containing all professionals. Moreover, it makes a great deal of difference to educational planning whether physical plant and facilities are to be provided for the education of accountants or engineers, and within group, whether electrical or industrial engineers are to be educated. The more advanced the

[2] When the difference between the states with the highest and the lowest productivity is small, say 20 to 30 per cent, there is little room to observe marked trends.

[3] One difficulty with using state data, in contrast to using international data, is that the occupational structure of an industry in a given state may come from establishments that specialize in the production of a few items. The product mixes of industry in each of several industrially diversified countries are probably more alike than they are in each of several states in the United States. Specialization in the products of a given industry is apt to be sharper among states than among nations.

[4] International Labour Office, *International Standard Classification of Occupations*, Geneva, 1958.

[5] Ibid., pages, 113–114.

occupational level the greater the likelihood of specialization and the greater the difficulty of moving to another professional specialty even within the same profession.

The second and by far the more serious problem is the proclivity to classify occupations by product or by process rather than by level of skill or by degree of work complexity. In part, and only in part, this preference reflects the use of socio-economic categories rather than those based on technological considerations. But it also reflects the absence of a universal system for determining the complexity or skill of a job. ISCO often groups together blue-collar workers engaged in the same activity or industry, irrespective of skill level. This problem is prevalent on the three-digit level, and even the five-digit level is not immune to it. For example, ISCO has a five-digit occupation "Electrical Fitter (Domestic Appliances)", with the following description:

> "Fits, assembles and repairs electrical domestic appliances in factory; performs basic tasks similar to those of Electrical Fitter, General . . . but works on electrical domestic appliances, such as electric fans, vacuum cleaners and irons, of which special knowledge is required."[6]

Is this an all-round craftsman, a skilled fitter-assembler or merely a semi-skilled assembler? The implication is that he does all the tasks specified, but the likelihood is that he specializes in just one or two at most. Such a definition, in short, gives the coder too much discretion, particularly since ISCO does not provide an alternative classification for placing workers doing just one specialized job in the assembly of domestic appliances.

The merging of different skill levels makes it almost impossible to isolate occupations that probably are crucial to economic development. Skilled manual workers and first line supervisors too easily disappear in the abyss of "craftsmen and production workers" or (when the classification is based upon industry rather than socio-economic level) "chemical and related process workers". It would seem essential to separate skilled production workers from semi-skilled machine tenders or process workers. Similarly, unskilled workers or learners ought not to be included with skilled and semi-skilled workers.

The neglect of skill differences in classification is not restricted to blue-collar workers. It is almost endemic among white-collar and service worker categories, which bear the burden of somewhat archaic social distinctions rather than more useful functional distinctions. All censuses as well as ISCO treat managerial and administrative personnel alike as if the corporation president, the plant manager and the department foreman performed work at the same level of difficulty and required the same amount of training and experience. In some censuses the working proprietor is listed separately but this is relatively rare.

A somewhat better distinction between skill levels occurs in the classification of clerical and sales workers, because many job titles coincide with differences in the degree of work complexity or the amount of skill required. But even here there are disturbing lapses. Very often there is one all-inclusive category for office machine operators or for all sorts of specialized clerks, although the category may include a fairly broad range of skill levels. Sales clerks who may not be much more than package wrappers and money collectors are indiscriminately classed with sales men and women who have to persuade customers to buy expensive consumer durables. There may be good reasons for combining such disparate occupations, but ranking jobs by skill level is certainly not one of them.

Finally, no census tries to differentiate service jobs by degree of complexity, except in a very rough, accidental fashion. Thus service workers are often subdivided into those working in households and those working elsewhere, the inference being that the former are at the bottom of the skill scale. ISCO has a fairly elaborate classification of service workers, but it is necessary to consult the five-digit level before skill differences can be distinguished; and even here there are difficulties. First, skill differentiations are largely fortuitous, the result of conventional ways of labelling and grouping jobs rather than of any systematic effort to rank them by complexity. No census tries to do this, and the defect is not unique to ISCO. Second, even the rough skill differentiations discernible at the five-digit level have ambiguities. This feature also is not unique to ISCO.

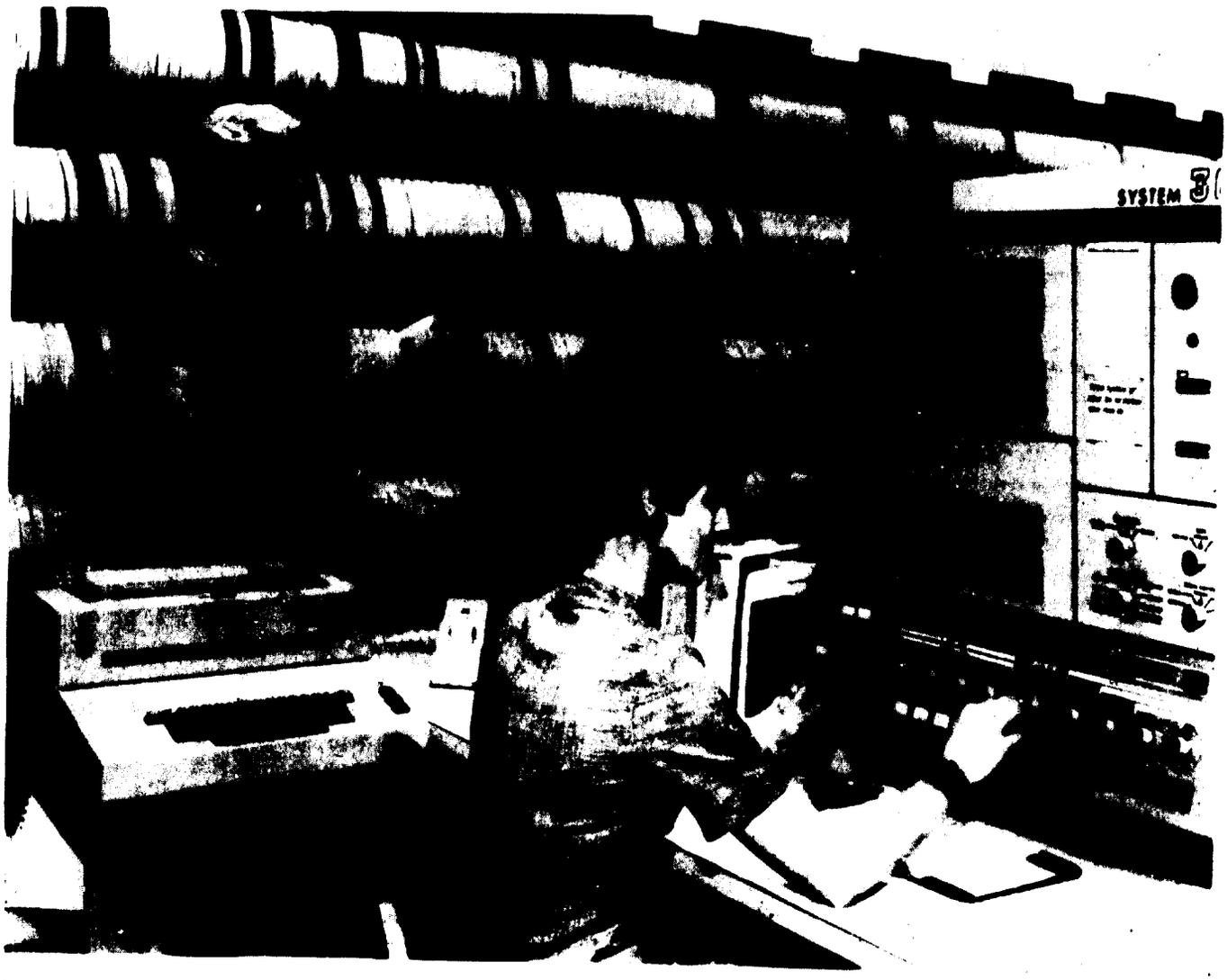
A few examples are in order. How does a cook compare in terms of skill with a policeman, or a beautician with an airline stewardess? The difficulty is even greater when one tries to make comparisons between major groups. Is a keypunch operator or a telephone operator the equivalent of a stewardess? And how do all three compare with a rolling mill operator or a carpenter? There are no guidelines here. It is assumed, more or less, that the clerical worker and the service worker, except for drudges, need more formal schooling than the blue-collar worker, and that therefore the former is "above" the latter in some way. In terms of experience and training, however, the rolling mill operator and carpenter probably are "superior" to the average clerk or service worker.

We have just stumbled upon our last problem. Census occupational data are gathered without regard to the content of the jobs reported. Only job content can offer clues about the degree of complexity of the work and the degree of skill needed to perform it. For example, what is a cook? Is he a chef or an exalted counter assistant? What is a machinist—an all-round craftsman, a job setter or the operator of a specialized machine tool, possibly completely automatic? Questions of content are especially important in comparisons of the occupational structures of industries at different levels of mechanization. Job titles by themselves can confuse the difference between modern machine skills and traditional artisan skills. The more technically advanced an enterprise or industry the greater the likelihood of specialization and the greater the likelihood that the work will not require traditional skills, even though the

[6] Ibid., page 126.

An apprentice carpenter at Colombo, Ceylon

Computer operators in California, U.S.A.



Arab technicians in a repair shop at Dhahran, Al Hasa, in Saudi Arabia

A draughtsman at work in Rangoon, Burma

traditional titles continue to be used. Thus a low productivity textile industry might have a high proportion of skilled weavers, while a high productivity textile industry might have comparatively fewer weavers, most of whom are actually semi-skilled machine tenders. One could multiply such examples, with respect not only to manual-worker jobs but also to white-collar and service ones as well, as our earlier discussion suggests.

The occupational code we developed for our work reflects many of the dilemmas noted above.[7] We chose ISCO as our frame of reference on the grounds that other groups were also likely to use it, or a modified version of it. We first tried to rearrange ISCO's five-digit occupations according to broad skill categories, such as skilled, semi-skilled and unskilled for manual worker occupations, and higher-skilled and lesser-skilled for white-collar and service workers. However, the failure of ISCO and of most census data to delineate blue-collar skill levels, to account separately for supervisors, or to report occupational information in sufficient detail, forced us to abandon our original effort. We then adopted a classification system based upon occupational titles as reported by individual censuses rather than upon skill requirements. It was difficult to find data that did not mix in various ways blue-collar jobs of different degrees of complexity. We made no effort to rank managerial positions by skill, because only rarely were they reported in sufficient detail; nor is there a ranking system available for the purpose.

Our original classification scheme also sought to distinguish between blue-collar and service occupations that cut across industry lines (e.g., truck driver) and those that are more or less specific to an industry (e.g., tire builder, weaver). The objective was to minimize the number of classifications as well as to identify occupations that might affect multiple industries or, perhaps, the entire economy. Our revised classification retains this distinction to the same extent that existing census classifications do. Here again, however, job titles or names rather than skill level or work content are the basis of the classification and reporting of data. Some fundamental problems remain, however. One is the failure (perhaps inability) of census takers to obtain meaningful information about work content. Another is the absence of a method for ranking jobs by skill level or work complexity.[8]

Perhaps censuses of population should not be used to obtain extensive or detailed occupational information, which might better be secured from special establishment surveys similar to (or part of) regular manufacturing and industrial surveys or censuses. There probably is no other way of discovering what workers actually do, and it is this knowledge that underlies any systematic ranking of occupations by skill. There are further advantages of such a special survey or census. The occupational data would be grouped automatically by industry and, if desired, by establishment size as well. Such occupational data, moreover, would come from the same universe and cover the same time periods as the production data. Efforts to relate occupational structures and employment to productivity in an industry would be helped considerably by such a simple matter as ensuring that all the data referred to the same sector and date.

Problems of comparing productivities

Another difficulty is that arising in the comparison of productivities. This problem is prominent in all economies and despite numerous attempts to solve it, progress has been slow; thus practical measures of comparison are few. Differences in exchange rates, taxation policies and subsidies, wages, product mix, markets, depreciation policies, etc. make the task of comparing productivities of industries in different countries almost insurmountable. There is, however, an inverse relationship between the difficulty of comparing productivities and the relative differences in "real productivity". In other words, when industries of different countries use similar technologies it is much more difficult to rank productivities than when industries use very different technologies, such as a highly advanced technology compared with a simpler one. In an international sphere the wide range of industrial productivities facilitates the ranking of industries. Moreover, ranks can be based upon several criteria each of which can serve as a check on the other; value added per employee in local currency multiplied by a common exchange rate, power consumed per worker measured in metric tons of coal equivalent, and electricity consumed per worker measured in kWh are some of the alternatives. On the other hand, a disadvantage in making international productivities comparisons is the paucity of reliable observations, especially at the lower end of the productivity scale where it is hard to generalize on the basis of a limited number of observations. Nevertheless, we shall try to draw some conclusions with respect to the relationship between occupational compositions and productivity in manufacturing industries in different countries.

International comparisons

The data chosen came from Canada (1951), India (1956), Japan (1960), Turkey (1960), the United Kingdom (1951), and the United States (1960). Also included are Puerto Rican data for 1960. The productivity ranks and the occupational compositions of the different industries in each of these countries and in Puerto Rica are given in annex I. Four major occupational groups were used to

[7] "Classification of Occupations by Skill Level", Bureau of Business and Economic Research, Northeastern University, 1964, unpublished, miltilith.

[8] The Bureau of Employment Security of the United States Department of Labor has developed such a ranking system as a means of revising its *Dictionary of Occupational Titles*. The ranking method depends upon careful analysis of work content and worker functions, and in so far as the complexity of the work is concerned it does not permit comparisons among different occupational families: for example, one cannot compare the relative complexity of a truck driver's job with that of a typist. Moreover, the United States Bureau of the Census does not use the ranking system for its own occupational classification.

illustrate the point that there is a relationship between productivity and occupational structure. The number of occupations and countries is too small to be more than indicative. More conclusive evidence will have to wait until the collection of international data is completed.

The occupational data used are neither as refined nor as detailed as could be desired. For the reasons mentioned in the section dealing with occupational classifications, it was impossible to group the occupational data of all the countries on the basis of skill levels, with the exception of the completely unskilled group. Most blue-collar occupations reported by Puerto Rico, India and Japan are mixtures of skills (i.e., combinations of skilled and semi-skilled). The alternative to using a very detailed (e.g., 3-digit) classification that did not necessarily reflect skill levels (nor necessarily include all countries) was to list blue-collar occupations in a single category. The same admixture of skills exists in other major occupational groups, excepting those of the professional and technical. Furthermore, detailed data (e.g., a three-digit classification) are either incomplete or not available from some countries. In the case of Turkey, for example, the available data give only a total figure for managerial and clerical occupations combined and also for professional and technical combined. In the case of India the reported figures of professional and technical workers seem to include skilled craftsmen and supervisors, thus inflating the proportion of high level occupations in industrial work forces. Despite these shortcomings, however, general tendencies can be seen between the occupational groupings and productivity.

In all industries, except printing and publishing, there is a direct relationship between professional and technical workers and productivity. As productivity increases, the proportion of professionals and technicians rises. The proportion of professionals, taken by itself, behaves in a similar way although somewhat less consistently. For example, in the textile industry there is no obvious relationship between the proportion of professionals and productivity. The proportion of technicians, however, is less consistent than that of professionals. Almost every industry in the United Kingdom shows a higher proportion of technicians than one would expect if there were a consistent trend for this occupational group. Perhaps technicians in the United Kingdom do many jobs done by professionals elsewhere, or conversely many professionals in the United States and Canada do work that technicians could do. In any event, it seems that in general as productivity rises, so does the proportion of technicians.

In contrast, the proportion of white-collar workers in many industries seems to evidence no distinct pattern as productivity changes. A pattern does seem to emerge in the textile, fabricated metal, machinery, and rubber products industries. However, this pattern is dim and appears only if Japan is excluded. Japan seems to be a special case; in relation to the productivity rankings the proportion of white-collar workers is unusually high in many industries. This peculiarity may reflect traditional employment practices or special social conditions. Within the white-collar group, managers, officials and proprietors (which exclude foremen), also show no relationship to productivity. It seems that the assertion that an increase of the proportion of managers results in an increase of productivity is unfounded, once a minimum proportion is established. State data for the United States corroborate these findings for the international sphere. Of course, we cannot conclude that there is no connexion between the *quality* of management and productivity. Further, the broad nature of the managerial classification may conceal a distinctive trend for a specific type of manager such as plant managers or company executives responsible for planning, but the data available to us at the present time do not reveal any obvious relationships.

The proportions of the clerical and sales group also show little or no systematic change with regard to productivity. Nevertheless, certain types of industries appear to have a unique proportion of white-collar workers which differs from that of other types of industries. Petroleum and coal products, printing and publishing, and chemical industries, for example, have on the average higher proportions of white-collar workers than do apparel and other finished textile, textile or fabricated metal industries.

Although insignificant in terms of their proportion of the total working force, service workers as a group present a distinct pattern in industry, if the countries in our table are grouped on the basis of predominantly high or low productivity industries. In general industries in countries with predominantly low-productivity industries have a high proportion of service workers in comparison with the industries in high productivity countries. The intra-group relationships are extremely weak. Our finding corresponds with patterns observed in less developed countries, where one usually is surprised, when visiting local plants or administrative offices, to find so many functionaries engaged in service activities, primarily unskilled in nature. This apparent prolificacy may be a consequence of low wages as well as of entrenched traditions and social mores.

The proportion of blue-collar workers in the labour force is generally inversely related to productivity. This trend is even stronger in the proportion of unskilled workers. We must emphasize, however, that other and more clear-cut patterns are probably hidden within the all-inclusive skilled and semi-skilled group, which inadvertently includes even working foremen and supervisors. These internal shifts disappear with aggregation. Only a very disaggregated occupational classification system can provide the means of discerning the occupational patterns related to productivity that are useful for manpower planning.

Education and manpower needs

The assertion that an industry's productivity depends on the composition of its labour force and that a detailed classification of occupations is needed for efficient manpower planning conflicts to a certain extent with the

position of those who hold that the educational level of a nation's population is a major determinant of productivity. It is not the educational level, but the skills of a nation's work force that seem to count most, and the two are not necessarily synonymous.[9] A traditional index of the qualifications needed for an occupation is the educational level of its practitioners, but this is by no means the only standard by which to judge occupational requirements. Economists and educators, especially the latter, tend to stress formal education but not the other important ways by which people acquire skills.[10]

A great deal of attention has been and continues to be paid to the education of professional and technical workers. One possible reason is that the gestation period for these occupations is long (an engineer's education, for example, takes at least an additional nine to ten years after elementary school), but there is generally only one way to become a professional and that is fairly well defined. The less conspicuous but yet important skilled manual workers have until recently attracted much less attention from educators and economists, despite their numbers and their role in production. It is therefore not surprising that there is little knowledge about the level of education or the amount of training needed by those in semi-skilled or in skilled blue-collar jobs. Although the way to become a skilled worker is not clearly delineated, the training of a craftsman may require years of formal schooling as well as additional years of on-the-job training and work experience. To complicate matters further, training may be substituted for schooling and *vice versa*, and skills appropriate to one occupation may be transferable in varying degrees to other occupations. Thus there are multiple paths of skill acquisition all leading to the same objective – to turn out a person who can meet the work requirements of an occupation. Statements to the effect that formal education automatically yields a higher level of productivity, while not particularly useful in practical manpower planning, may even have harmful results in countries that lack the resources to educate formally large masses of people destined to become blue-collar workers. The fact that there are countries with both high average levels of education and high levels of industrial productivity may reflect more than an occupational structure heavily weighted with occupations that require extensive knowledge and broad abilities obtainable only after years of formal schooling. While such high average levels of education are made possible by high *per capita* real incomes, this amount of education may be more than what is needed solely to accomplish the work of the economy.

The view that educational levels in some industrially advanced countries exceed occupational needs seems to be supported by international comparisons of the years of schooling of workers in given lines of work. The table in annex II compares a few specific occupations taken from clerical, service and skilled worker categories in Canada, Japan, the United Kingdom and the United States. The years of schooling are approximations, because each country either collects somewhat different information or groups it differently. For example, Canadian years of schooling are arranged in the following categories: 0–4, 5–8, 9–12 and 13 years or more. United States years of schooling are presented differently: 0–4, 5–7, 8, 9–11, 12, 13–15, 16 and 17 years or more. On the other hand, the United Kingdom does not give years of schooling but the age at which formal education is completed. Age of completion must then be translated as best as possible into corresponding years of schooling.[11] However, we could not take into consideration differences in quality of education. Moreover, the broad years-of-schooling distributions obscure the number of persons who failed to complete elementary or secondary school. Nevertheless, if we assume that workers in the same occupations in different countries have even approximately the same capabilities, then the differences in years of schooling for the same occupations in different countries are so great that we cannot help but conclude that educational levels in high productivity countries are in part the result of an education demand not unlike the demand for an income elastic consumer good. Technology alone is not the sole explanation.

In planning for the training of skills, the *minimum* level of education needed before a person can learn to perform effectively the duties of an occupation, the different rates of substitution between formal education and other forms of training are important considerations. Developing nations, with limited resources, have to be especially careful to choose the most efficient and economical ways to impart scarce skills. They should not be swayed by the example of the more prosperous nations where the blue-collar worker is probably overeducated (from the limited standpoint of production requirements, see annex II).

Use of input-output techniques in planning manpower requirements for development

Our assumption of a unique link between the level of productivity in an industry and the occupational distribution

[9] It will be helpful to keep in mind that when we refer to occupations we have in mind functions. We are not evaluating the general capacity or the alternative abilities of the individual who happens to be performing a particular function. In other words, when we say that industry *A* requires a certain percentage of electricians to achieve a specified level of productivity, we assume that workers assigned the tasks and duties associated with the job description of electrician are in fact reasonably competent electricians. In effect, we classify a worker according to his duties. If a lawyer, for example, is working as a foreman, we consider him a foreman and not a lawyer.

[10] There are probably many reasons for this predilection. First, there is little concrete information about how people actually acquire specific skills of a non-professional nature. Second, it may be worth while noting that economists and educators, being themselves professionals whose vocational preparation has been almost exclusively formal in nature and has rested upon an earlier period of unspecialized general education, tend apparently to generalize their own experiences and their knowledge of other professions to all types of jobs.

[11] This type of translation can be no more than an approximation, as it was in the case of the United Kingdom data, despite the use of the excellent descriptions of educational structures in UNESCO's *World Survey of Education—II*, Paris, 1958.

of its labour force allows the incorporation of occupational data into general input-output models. General input-output models assume: (*a*) fixed capital-labour coefficients; (*b*) fixed interindustry coefficients; (*c*) a unique technology for every sector; and (*d*) homogeneous labour. As in the general model our model assumes that interindustry coefficients are constant, but unlike the general model it also assumes that (*a*) the productivity of an industry is a function of its occupational composition, (*b*) the amount of capital employed is a function of the occupational composition, (*c*) there are many technologies and hence productivities available to each sector, and (*d*) the occupational composition of the population as a whole is known.[12]

What is the advantage of this model over the general input-output model? The input-output model implicitly assumes that the economy possesses or has the ability to generate the skills needed for the implementation of the desired outputs (i.e., the development plan). If the skills needed for the plan are not forthcoming, not only is one industry affected but the entire plan suffers. For example, if the chemical industry has a specific employment and production goal, and there is a shortage of trained personnel like electricians, productivity may drop and the production fall short of the mark. This lost output in turn may affect production in industries supplied by the chemical industry. The assumption of a fixed productivity per sector also hinders maximization of output criteria, because the production boundary is determined by the productivity assumed. To assume that a range of productivity is available per sector removes to some extent the restriction imposed by a single choice of productivity. There thus is a greater likelihood of maximizing total output.

More important, with the introduction of the manpower variable we can avoid the pitfall of developing a plan that may from the outset be doomed to failure because of a lack of qualified manpower. The introduction of boundaries imposed by the availability of occupational skills makes possible a feasible solution for the plan or the I-O model. Moreover, each industry can have a variety of productivities (and hence occupational distributions) and capital requirements. We may choose, for example, to have high productivity in metals and low productivity in textiles, or high productivity in chemicals and low productivity in food and beverages. The choice of productivity will be governed in part by the allocation of scarce skills. This point can be illustrated by the following example. Assume a country with two industries, *A* and *B*, and with a scarcity of mechanical engineers relative to technicians. Now suppose that an increase in productivity in industry *A* depends to a large degree upon increasing the proportion of mechanical engineers in its work force and decreasing that of technicians. In other words, if we reduce the proportion of engineers and increase that of technicians, productivity in this industry will fall significantly. In contrast, suppose that in industry *B* an increase of productivity depends more upon a higher proportion of technicians than upon a higher proportion of engineers. Here a reduction in the relative numbers of engineers will not reduce productivity significantly. In this highly simplified case it may be worth while to shift mechanical engineers from *B* to *A*. The combined productivity of *A* and *B* may rise as a result.

In other cases, productivity in an industry, say *X*, is unaffected by moderate changes in the proportion of a given occupation in the work force, but still requires a minimum proportion for effective functioning (as seems to be true of managers in a number of industries). At the same time productivity in another industry, say *Z*, may depend upon the proportion of its employees in this particular occupation. If the number of people with the skills required by this occupation is limited, and if they are already employed at this work, total production may be increased by shifting such workers from *X* to *Z*, provided their proportion in *X*'s work force does not fall below the minimum level. In this instance it may not be advisable to try to increase productivity of industry *Z* until the supply of the requisite skill has increased. The decision will depend upon the productivity gain desired in industry *Z*, and consequently upon the number of workers with the necessary skills that industry *X* must give up. Extension of this reasoning to incorporate a large number of industries requires a general model that takes account of all their particular manpower requirements.

Industry data versus plant data

In practice an input-output model that incorporates manpower requires a knowledge of the occupational mixes and corresponding productivities of different industries. The usefulness of such occupational matrices has been challenged on the grounds that the occupational composition of an industry comes from a mixture of technologies and products, and therefore cannot be used to determine the composition of the labour force of a plant or of a limited number of plants. This argument is valid at one level of decision-making but not at another.

Unquestionably, if we want to build a single plant and if we know precisely the products to be produced and the technology to be used, the best way of determining the staffing pattern is to refer to engineering data in the hands of equipment producers or engineering consultants. However, a general development plan deals for the most part with unknown or only partially known product mixes of a number of different industries. It also deals with varying technological stages in each industry, because an industry does not contain only plants with identical ages or identical technologies. Further, the plan will have to take account somehow of future changes in these technologies. It cannot be assumed that an industry will duplicate in the future the types of techniques and the mix of products in the same proportions as the plants that furnished the data used in

[12] In annex III an example is presented for the simple case of three sectors and three skills to illustrate how the system of equations of such an input-output model is developed.

preparing the plan. Nor can it be assumed that the exact future composition of the industry will be known in advance. Further, new plans alone cannot tell us the future composition of an industry. Industrial expansion is the net result of the addition of new plants (or operations) at one end of the technological spectrum, the scrapping of old plants at the other end, and the replacement of those in between. The net change in occupational structure thus reflects the difference between the added plants (or processes) and the scrapped plants (or processes). To consider only the potential additions ignores the scrapped plants and the replacement needs of continuing operations.

Reliance upon plant data is especially unwarranted in the case of plans whose purpose is the provision of general policy recommendations rather than concrete projects and detailed direction. If a nation's policy is the encouragement of industrial expansion in a free market environment, industrial managers will have to be allowed to determine the proper mix of products and techniques within the framework of the market or of otherwise established incentives. Decentralized decisions with respect to products and techniques cannot be predicted accurately. The use of industry data from different countries in effect assumes that these decisions have already been made. In a free market, then, unless we know the number and nature of the products of all future plants in an industry, the use of data from existing plants, whether in the same country or in others, will lead to serious errors. Plant data are valuable only if the precise plant and product composition of the future industry is known. In short, the degree of disaggregation in the data cannot be finer than the level of decision-making. Industry data offer a better chance than plant data of yielding offsetting, rather than reinforcing, errors. The use of industrial occupational structures to forecast the occupational needs of an economy contains the possibility of two types of errors – an error in occupational mix and an error in assessing the importance of a specific industry in the total economy. Unless all (or most) industry forecasts are biased in one direction, errors in them are likely to cancel out and thus help to prevent incorrect occupational forecasts for the over-all economy. Errors in forecasting occupational mixes are likely to produce similar cancelling effects.

A feasibility test and the use of tables of industrial occupational structures

The procedure of most development plans is to project production targets first and only afterwards to refer the results to a manpower expert for forecasts of the labour that will be needed. The usual purpose of a manpower projection is to enable the authorities to plan the educational facilities that will be required to furnish the necessary skills. Sometimes plans are implemented even when manpower projections are not available, but the chances of success are reduced considerably by their lack. Such planning procedure can be costly and disappointing. The manpower planner can help to avoid such failures by playing a much more fundamental role than simply assisting to implement part of an already conceived plan. He can check the feasibility of a plan by determining whether the requisite occupational skills are or will be available to complement the proposed investments. Moreover, he can indicate alternative ways of using available manpower, and can formulate policies to prevent potential imbalances in the future demand and supply of skills. Tables of industrial occupational structures and their corresponding productivities (see annex I) thus provide the manpower planner and the general planner with an ideal tool for testing the practicality of a development plan.

This manpower feasibility test can be expressed in the following way: If productivity of industry j is a function of x_{ij} then

$\sum_{j=1}^{n} x_{ij} L_j \leq \overline{X}_i$ where $\overline{X}_i$ is the available supply of occupation i, x_{ij} is the proportion of people with occupation i in the work force of industry j, and L_j is total employment in industry j.

Maximizing employment and allocating labour

There are also other important uses of tables of industrial occupational structures. They can help the allocation of investment with a view to maximizing employment. A rapid increase in productivity in one industry may displace a large amount of unskilled labour and at the same time put pressure on some scarce occupation. When the two types of labour cannot be mutually substituted, one way to provide employment for the displaced is to expand industries that employ them in relatively large numbers. Another way is to increase the supply of the scarce skill. Tables linking changes in the occupational mixes and in the productivities of different industries may suggest which industries should be encouraged in order to absorb workers of a given type. Such tables also can suggest which industries should be discouraged from adopting new techniques if the only way to carry them out is by pirating irreplaceable key workers from other equally essential industries.

Improving manpower forecasts

The occupational compositions of various industries offer fairly good clues as to the importance of different occupations in different industries and serve to identify occupations unique to one industry (or to a few) and cross-industry occupations (those used in many industries). A worker with a skill specific to one industry (like that of a tire vulcanizer) may find it difficult to make interindustry transfers without special retraining. Errors in forecasting the number of persons in a cross-industry occupation (such as electricians) who work in one industry may be compensated by an error in the opposite direction for another industry. Errors in forecasting the demand for jobs specific to an industry, on the other hand, can be more serious, because of the unlikelihood of similar offsets. Forecasts of

occupations specific to an industry must therefore be more accurate than forecasts of cross-industry occupations. Industrial occupational structures thus offer a way of ensuring greater accuracy of forecasts where needed.

Verifying productivity

Another use of tables of industrial occupational structures and their corresponding productivities is in ranking the productivity of an industry in one country or region when the figure is uncertain. If an occupational structure varies consistently with productivity, it is possible to compare the occupational structure of a geographical sector of the industry with those of two other geographical sectors of the industry whose productivities are known. In any case, occupational structures should and can be a complementary way of verifying international comparisons of industrial productivity.

Training workers

These tables, together with information about the different ways in which skills are acquired (paths of skill acquisition), can do more than provide a basis for planning educational facilities: they can also help us to make the best use of existing and planned facilities for on-the-job training, an important source of skills that has received little attention until recently.

To summarize, industry occupational tables are a means of making more realistic manpower projections. These tables also serve such subsidiary functions as verifying dubious productivity data, improving the short-run allocation of labour, avoiding chronic unemployment, and improving the use of in-plant training facilities.

ANNEXES

ANNEX I

PRODUCTIVITY RANKINGS AND PERCENTAGE COMPOSITION OF THE LABOUR FORCE IN MANUFACTURING INDUSTRIES FOR SELECTED COUNTRIES AND YEARS

Note: Countries are ranked by productivity. In the table for each industry the country to the left has the highest productivity level, and productivity declines to the right. Figures do not necessarily total 100 per cent because of rounding differences and omission of unspecified occupations or in a few cases of unreported ones; n.a.: data not available. Sources are given at the end of this annex.

Food and beverages—ISIC 20 and 21

	United States 1960	*Canada 1951*	*United Kingdom 1951*	*Puerto Rico 1960*	*Japan 1960*	*Turkey 1960*	*India 1956*
Professional and technical	*2·1*	*2·3*	*1·5*	*1·1*	*0·7*	*1·1*	*1·9*
Professional	1·5	1·7	1·0	1·0	n.a.	n.a.	n.a.
Technical	0·6	0·6	0·5	0·1	n.a.	n.a.	n.a.
White collar	*34·0*	*24·0*	*20·3*	*22·5*	*24·8*	*12·6*	*n.a.*
Managers, officials and proprietors	7·4	6·9	5·0	6·7	5·3	0·9	1·4
Clerical	10·0	12·0	10·8	5·6	9·0		
Sales	16·6	5·1	4·5	10·2	10·5	2·7	n.a.
Service workers	*0·4*	*1·0*	*0·1*	*n.a.*	*1·3*	*3·2*	*2·5*
Blue collar	*61·0*	*72·7*	*77·8*	*73·6*	*70·5*	*83·1*	*88·0*
Skilled and semi-skilled	44·9	49·1	44·2	n.a.	n.a.	n.a.	16·7
Unskilled	16·1	23·6	33·6	n.a.	n.a.	n.a.	71·3
TOTAL	97·5	100·0	99·7	97·2	97·3	100·0	93·8

Tobacco and tobacco products—ISIC 22

	United States 1960	*Canada 1951*	*United Kingdom 1951*	*Japan 1960*	*Turkey 1960*
Professional and technical	*1·8*	*1·2*	*0·9*	*2·2*	*n.a.*
Professional	1·1	1·2	0·2	n.a.	n.a.
Technical	0·7	0·0	0·7	n.a.	n.a.
White collar	*15·4*	*20·2*	*21·9*	*31·5*	*4·5*
Managers, officials and proprietors	4·0	3·6	2·9	4·1	2·5
Clerical	7·1	14·2	16·1	25·5	2·0
Sales	4·3	2·4	2·9	0·9	
Service workers	*n.a.*	*n.a.*	*0·2*	*4·1*	*1·5*
Blue collar	*81·9*	*73·1*	*73·1*	*60·3*	*94·0*
Skilled and semi-skilled	62·1	54·3	61·0	n.a.	n.a.
Unskilled	19·8	18·8	12·1	n.a.	n.a.
TOTAL	99·1	94·5	96·1	98·1	100·0

Textile mill products—ISIC 23

	United States 1960	*Canada 1951*	*United Kingdom 1951*	*Puerto Rico 1960*	*Japan 1960*	*Turkey 1960*	*India 1956*
Professional and technical	*1·7*	*1·8*	*1·1*	*1·4*	*0·4*	*0·7*	*1·1*
Professional	1·1	1·0	0·5	1·1	n.a.	n.a.	n.a.
Technical	0·6	0·8	0·6	0·3	n.a.	n.a.	n.a.
White collar	*11·2*	*13·4*	*8·6*	*6·1*	*11·2*	*4·1*	*3·7*
Managers, officials and proprietors	2·8	3·4	2·7	1·8	3·5	3·7	0·6
Clerical	7·2	8·8	5·3	3·2	6·2		3·1
Sales	1·2	1·2	0·6	1·1	1·5	0·4	n.a.
Service workers	*0·1*	*0·6*	*0·1*	*n.a.*	*1·5*	*1·3*	*0·8*
Blue collar	*84·2*	*83·6*	*90·1*	*92·6*	*87·1*	*93·9*	*94·4*
Skilled and semi-skilled	76·7	69·0	73·7	n.a.	n.a.	n.a.	57·9
Unskilled	7·5	14·6	16·4	n.a.	n.a.	n.a.	36·5
TOTAL	97·2	99·4	99·9	100·0	100·0	100·0	100·0

Lumber and wood products except furniture—ISIC 25

	United States 1960	*United Kingdom 1951*	*Japan 1960*	*Turkey 1960*
Professional and technical	*1·2*	*0·8*	*0·1*	*n.a.*
Professional	0·6	0·4	n.a.	n.a.
Technical	0·6	0·4	n.a.	n.a.
White collar	*12·9*	*10·7*	*13·8*	*5·5*
Managers, officials and proprietors	6·1	4·4	4·4	
Clerical	5·5	5·7	6·7	5·3
Sales	1·3	0·6	2·7	0·2
Service workers	*n.a.*	*0·1*	*0·3*	*0·2*
Blue collar	*83·7*	*88·5*	*n.a.*	*n.a.*
Skilled and semi-skilled	60·7	68·3	n.a.	n.a.
Unskilled	23·0	20·2	n.a.	n.a.
TOTAL	97·8	100·1	—	—

Apparel and other finished textile products—ISIC 243 and 244

	United States 1960	Canada 1951	United Kingdom 1951	Puerto Rico 1960	Japan 1960	Turkey 1950
Professional and technical	1·0	1·2	0·1	0·3	0·3	0·1
Professional	0·4	1·2	0·0	0·2	n.a.	n.a.
Technical	0·6	0·0	0·1	0·1	0·3	n.a.
White collar	13·7	15·5	10·6	5·9	11·3	7·4
Managers, officials and proprietors	4·0	5·6	4·2	2·4	0·6	7·2
Clerical	7·1	7·3	5·1	2·7	4·9	
Sales	2·6	2·6	1·3	0·8	5·8	0·2
Service workers	0·3	0·6	0·2	n.a.	0·2	0·1
Blue collar	83·4	82·5	88·7	93·7	85·7	92·4
Skilled and semi-skilled	80·1	78·3	82·6	n.a.	n.a.	n.a.
Unskilled	3·3	4·2	6·1	n.a.	n.a.	n.a.
TOTAL	98·4	99·8	99·6	99·9	97·5	100·0

Furniture and fixtures—ISIC 20

	United States 1960	United Kingdom 1951	Japan 1960	Turkey 1960
Professional and technical	2·0	0·9	0·2	0·8
Professional	1·2	0·3	n.a.	n.a.
Technical	0·8	0·6	n.a.	n.a.
White collar	17·5	11·9	13·9	9·9
Managers, officials and proprietors	5·4	4·4	3·9	9·1
Clerical	9·1	6·0	5·0	
Sales	3·0	1·5	5·0	0·8
Service workers	n.a.	0·0	0·3	n.a.
Blue collar	80·5	87·2	85·6	89·3
Skilled and semi-skilled	73·1	77·1	n.a.	n.a.
Unskilled	7·4	10·1	n.a.	n.a.
TOTAL	100·0	100·0	100·0	100·0

Paper and paper products—ISIC 27

	United States 1960	Canada 1951	United Kingdom 1951	Japan 1960	Turkey 1960
Professional and technical	5·0	4·8	2·2	0·8	4·3
Professional	3·2	3·1	1·4	n.a.	n.a.
Technical	1·8	1·7	0·8	n.a.	n.a.
White collar	18·1	15·4	15·0	17·2	n.a.
Managers, officials and proprietors	4·4	3·5	3·4	4·4	8·5
Clerical	10·7	10·5	9·9	10·5	
Sales	3·0	1·4	1·7	2·3	n.a.
Service workers	0·1	1·1	0·3	1·1	6·4
Blue collar	74·3	78·2	82·6	78·5	80·9
Skilled and semi-skilled	62·5	53·2	54·6	n.a.	n.a.
Unskilled	11·8	25·0	28·0	n.a.	n.a.
TOTAL	97·5	99·5	100·1	97·6	100·0

Printing, publishing and allied products—ISIC 28

	United States 1960	Canada 1951	United Kingdom 1951	Puerto Rico 1960	Japan 1960	Turkey 1960	India 1950
Professional and technical	9·1	9·0	7·0	11·5	10·1	15·4	4·1
Professional	8·1	8·3	5·8	10·9	n.a.	n.a.	n.a.
Technical	1·0	0·7	1·2	0·6	n.a.	n.a.	n.a.
White collar	30·7	32·2	22·8	36·7	29·0	14·6	14·0
Managers, officials and proprietors	7·5	8·1	5·9	13·9	6·5		3·4
Clerical	17·2	10·0	14·7	12·9	17·8	13·8	10·4
Sales	6·0	5·1	2·2	9·9	4·7	0·8	0·2
Service workers	0·1	n.a.	0·1	n.a.	0·5	2·5	1·0
Blue collar	57·1	57·2	67·8	51·9	59·2	67·6	80·8
Skilled and semi-skilled	38·0	48·3	53·4	n.a.	n.a.	n.a.	53·4
Unskilled	19·1	8·9	14·4	n.a.	n.a.	n.a.	27·4
TOTAL	97·0	98·4	97·7	100·0	98·8	99·9	99·9

Leather and leather products —ISIC 29*

	United States 1960	Canada 1951	United Kingdom 1951	Japan 1960	Turkey 1960	India 1950
Professional and technical	0·9	0·8	0·8	0·2	0·1	0·4
Professional	0·6	0·5	0·4	n.a.	n.a.	n.a.
Technical	0·3	0·3	0·4	n.a.	n.a.	n.a.
White collar	16·1	13·3	13·6	14·9	7·1	9·2
Managers, officials and proprietors	5·9	4·7	5·9	3·2	6·9	5·1
Clerical	8·1	6·5	6·3	6·9	n.a.	3·6
Sales	2·1	2·3	1·4	4·8	0·2	0·5
Service workers	n.a.	0·3	n.a.	0·4	2·3	0·6
Blue collar	79·1	85·4	85·3	84·5	90·5	89·9
Skilled and semi-skilled	70·2	76·5	68·7	n.a.	n.a.	n.a.
Unskilled	8·9	8·9	14·6	n.a.	n.a.	n.a.
TOTAL	96·1	100·0	97·7	100·0	100·0	100·0

* Data of Canada, Japan and Turkey include leather footwear. Data of United States, United Kingdom and India do not include footwear. Specific name for industry in India: "Tanning".

Rubber products—ISIC 30

	United States 1960	Canada 1951	United Kingdom 1951	Japan 1960	Turkey 1960
Professional and technical	6·0	4·2	3·2	1·5	1·3
Professional	4·4	2·8	1·3	n.a.	n.a.
Technical	1·6	1·4	1·9	n.a.	n.a.
White collar	19·3	18·9	16·7	15·3	n.a.
Managers, officials and proprietors	4·5	3·7	3·3	2·2	8·0
Clerical	12·1	13·5	11·8	10·6	
Sales	2·7	1·4	1·6	2·5	n.a.
Service workers	0·2	n.a.	0·1	0·6	1·3
Blue collar	71·5	75·8	77·2	81·3	89·3
Skilled and semi-skilled	62·6	63·8	53·4	n.a	n.a.
Unskilled	8·9	12·0	24·3	n.a.	n.a.
TOTAL	97·0	98·9	97·7	98·7	99·9

Chemicals and chemical products—ISIC 31

	United States 1960	Canada 1951	United Kingdom 1951	Puerto Rico 1960	Japan 1960	India 1956
Professional and technical	15·4	9·3	8·8	6·2	3·7	4·8
Professional	10·4	5·8	4·5	5·1	n.a.	n.a.
Technical	5·0	3·5	4·3	1·1	n.a.	n.a.
White collar	27·6	35·4	24·6	28·0	27·1	8·2
Managers, officials and proprietors	6·8	7·4	4·9	6·9	4·2	2·4
Clerical	14·9	19·6	16·8	12·9	19·9	5·7
Sales	5·9	8·4	2·9	8·2	3·0	0·1
Service workers	0·1	0·4	0·4	n.a.	2·4	1·2
Blue collar	55·9	49·7	66·3	65·4	64·7	85·8
Skilled and semi-skilled	43·8	33·1	35·5	n.a.	n.a.	15·5
Unskilled	10·1	16·6	30·8	n.a.	n.a.	70·3
TOTAL	97·0	94·8	100·1	99·6	97·9	100·0

Petroleum and coal products—ISIC 32

	United States 1960	Canada 1951	United Kingdom 1951	Japan 1960	Turkey 1960	India 1956
Professional and technical	14·9	12·5	8·7	4·[illegible]	11·6	5·6
Professional	10·5	8·4	4·6	n.a.	n.a.	n.a.
Technical	4·4	4·1	4·1	n.a.	n.a.	n.a.
White collar	26·4	24·0	14·7	30·9	11·6	6·2
Managers, officials and proprietors	5·8	4·9	2·4	5·2	11·6	2·0
Clerical	17·8	16·9	11·8	22·0		4·2
Sales	3·1	2·2	0·5	3·[illegible]	n.a.	n.a.
Service workers	0·3	1·6	0·3	5·2	5·8	1·0
Blue collar	55·9	59·9	70·7	54·0	69·9	84·5
Skilled and semi-skilled	47·3	45·9	39·7	n.a.	n.a.	24·2
Unskilled	8·6	14·0	31·0	n.a.	n.a.	60·3
TOTAL	97·4	98·0	94·4	94·8	98·9	97·3

Stone and clay products—ISIC 331, 333, 334 and 339

	United States 1960	United Kingdom 1951	Turkey 1960	India 1956
Professional and technical	4·6	1·9	2·0	2·5
Professional	3·3	1·0	n.a.	n.a.
Technical	1·3	0·9	n.a.	n.a.
White collar	18·9	10·8	9·1	5·6
Managers, officials and proprietors	6·9	3·9	8·8	1·6
Clerical	9·3	6·2		4·0
Sales	2·7	0·7	0·3	n.a.
Service workers	n.a.	0·7	3·0	1·5
Blue collar	73·8	86·7	85·9	90·3
Skilled and semi-skilled	56·2	59·0	n.a.	24·3
Unskilled	17·6	27·7	n.a.	66·0
TOTAL	97·3	100·1	100·0	99·9

Primary metals—ISIC 34

	United States 1960	*United Kingdom 1951*	*Japan 1960*
Professional and technical	5·5	3·2	2·5
Professional	4·0	1·4	n.a.
Technical	1·5	1·8	n.a.
White collar	13·9	11·8	17·7
Managers, officials and proprietors	2·7	2·5	3·0
Clerical	10·1	9·0	13·9
Sales	1·1	0·3	0·8
Service workers	0·2	0·1	2·1
Blue collar	77·4	85·0	75·1
Skilled and semi-skilled	61·2	55·0	n.a.
Unskilled	16·2	30·0	n.a.
TOTAL	97·0	100·0	97·4

Iron and steel—ISIC 341

	United States 1960	*Canada 1951*	*United Kingdom 1951*	*India 1956*
Professional and technical	4·7	3·0	2·6	6·7
Professional	3·3	2·4	1·1	n.a.
Technical	1·4	0·6	1·5	n.a.
White collar	12·8	19·0	11·2	10·5
Managers, officials and proprietors	2·3	4·8	2·3	2·7
Clerical	9·7	12·3	8·7	7·8
Sales	0·8	1·9	0·2	n.a.
Service workers	0·1	0·4	0·4	2·4
Blue collar	79·6	77·0	85·8	80·4
Skilled and semi-skilled	61·3	63·4	54·9	35·7
Unskilled	18·3	13·6	30·9	44·7
TOTAL	97·2	99·4	100·0	100·0

Non-ferrous metals—ISIC 342

	United States 1960	*Canada 1951*	*United Kingdom 1951*	*India 1956*
Professional and technical	7·4	5·2	4·3	6·4
Professional	5·4	3·6	1·9	n.a.
Technical	2·0	1·6	2·4	n.a.
White collar	17·5	17·3	13·9	9·4
Managers, officials and proprietors	4·2	4·1	3·4	1·0
Clerical	11·3	11·2	10·1	8·4
Sales	2·0	2·0	0·4	n.a.
Service workers	0·1	0·2	0·2	5·4
Blue collar	72·8	75·6	80·8	78·3
Skilled and semi-skilled	63·0	59·8	54·1	33·6
Unskilled	9·8	15·8	26·7	44·7
TOTAL	97·8	98·3	99·2	99·5

Machinery except electrical – ISIC 36

	United States 1960	United Kingdom 1961	Puerto Rico 1960	Japan 1960	Turkey 1960
Professional and technical	9·2	5·9	3·3	2·4	4·5
Professional	6·1	1·7	2·6	n.a.	n.a.
Technical	3·1	4·2	0·7	n.a.	n.a.
White collar	21·2	16·9	10·6	20·8	n.a.
Managers, officials and proprietors	5·6	4·3	3·6	5·1	13·6
Clerical	13·2	11·7	6·0	13·9	
Sales	2·4	0·9	1·0	1·8	n.a.
Service workers	0·1	0·1	n.a.	1·1	4·5
Blue collar	67·2	78·1	86·2	74·4	77·3
Skilled and semi-skilled	62·3	63·1	n.a.	n.a.	n.a.
Unskilled	4·9	14·0	n.a.	n.a.	n.a.
TOTAL	97·7	100·0	100·1	96·7	99·9

Electrical machine equipment and supplies—ISIC 37

	United States 1960	Canada 1951	United Kingdom 1951	Japan 1960	Turkey 1960	India 1956
Professional and technical	15·2	7·0	6·2	3·1	3·8	5·3
Professional	10·0	4·7	2·4	n.a.	n.a.	n.a.
Technical	5·2	2·3	3·8	n.a.	n.a.	n.a.
White collar	20·1	19·5	18·0	22·4	8·4	8·6
Managers, officials and proprietors	4·3	0·8	3·3	3·1	7·5	1·3
Clerical	14·2	17·1	13·9	17·9		7·3
Sales	1·6	1·6	0·8	1·4	0·9	n.a.
Service workers	0·1	0·3	0·2	0·8	n.a.	0·3
Blue collar	62·5	66·8	73·6	72·6	87·7	85·7
Skilled and semi-skilled	57·7	59·0	58·3	n.a.	n.a.	42·7
Unskilled	4·8	7·8	15·3	n.a.	n.a.	43·0
TOTAL	97·9	93·6	98·0	98·9	99·9	99·9

Transportation equipment—ISIC 38

	United States 1960	Canada 1951	United Kingdom 1951	Japan 1960	India 1956
Professional and technical	12·4	2·8	3·9	3·6	4·0
Professional	9·3	1·9	1·2	n.a.	n.a.
Technical	3·1	0·9	2·7	n.a.	n.a.
White collar	16·4	16·1	11·5	18·1	8·3
Managers, officials and proprietors	2·8	5·1	2·0	2·2	1·7
Clerical	12·8	9·7	9·2	15·0	6·6
Sales	0·8	1·3	0·3	0·9	n.a.
Service workers	0·2	0·5	0·3	1·5	0·7
Blue collar	68·9	80·6	84·1	76·7	87·2
Skilled and semi-skilled	63·2	68·6	66·3	n.a.	50·2
Unskilled	5·7	12·0	17·8	n.a.	37·0
TOTAL	97·9	100·0	99·8	99·9	100·2

Fabricated metal products—ISIC 39

	United States 1960	*United Kingdom 1951*	*Japan 1960*	*Turkey 1960*	*India 1956*
Professional and technical	9·6	1·6	0·5	0·2	3·6
Professional	6·3	0·6	n.a.	n.a.	n.a.
Technical	3·3	1·0	n.a.	n.a.	n.a.
White collar	20·8	13·7	16·1	5·5	8·0
Managers, officials and proprietors	5·6	4·3	5·1	5·3	2·4
Clerical	13·1	8·8	9·2		5·5
Sales	2·1	0·6	1·8	0·2	0·1
Service workers	0·2	1·3	0·5	0·3	0·8
Blue collar	67·3	83·5	81·4	94·0	87·6
Skilled and semi-skilled	60·1	64·4	n.a.	n.a.	45·6
Unskilled	7·2	19·1	n.a.	n.a.	42·0
TOTAL	97·9	100·1	98·5	100·0	100·0

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ANNEX II

PERCENTAGE DISTRIBUTION OF WORKERS IN SELECTED OCCUPATIONS IN DIFFERENT COUNTRIES BY YEARS OF FORMAL SCHOOLING

Sources: See annex I for all but the United States. United States educational data were computed from Bureau of the Census, *U.S. Census of Population: 1960, Special Reports, Occupational, Characteristics*, Final Report PC (2)–7A, Washington, D.C., 1963. Figures do not necessarily total 100 per cent because of rounding differences in the classification and cases where the information is neither reported nor available.

	Years of schooling			
	0–4	*5–8*	*9–12*	*13+*
Draftsmen and designers				
Canada, 1951	—	8	57	35
Japan, 1950	—	23	53	23
United Kingdom, 1951	29		63	4
United States, 1960	—	3	49	47

	Years of schooling			
	0–4	5–8	9–12	13+
Cashiers and bookkeepers				
Canada, 1951	—	11	71	17
Japan, 1950	—	23	59	17
United Kingdom, 1951	39		55	1
United States, 1960	—	8	73	18
Secretaries, stenographers and typists				
Canada, 1951	—	5	77	18
Japan, 1950	—	21	71	8
United Kingdom, 1951	29		65	1
United States, 1960	—	2	72	26
Telephone operators				
Canada, 1951	—	18	77	5
Japan, 1950	—	58	41	1
United Kingdom, 1951	55		39	—
United States, 1960	—	13	80	8
Tool and die makers				
Canada, 1951	2	29	58	11
Japan, 1950	6	73	23	—
United Kingdom, 1951	70		24	—
United States, 1960	1	24	66	9
Painters and paperhangers				
Canada, 1951	6	55	36	3
Japan, 1950	6	72	21	2
United Kingdom, 1951	80		13	—
United States, 1960	7	42	45	5
Bricklayers and masons				
Canada, 1951	9	57	31	3
Japan, 1950	11	75	18	—
United Kingdom, 1951	82		11	—
United States, 1960	7	37	51	5
Electricians				
Canada, 1951	2	35	55	8
Japan, 1950	1	60	33	5
United Kingdom, 1951	67		27	—
United States, 1960	1	23	65	10
Plumbers and pipe cutters				
Canada, 1951	4	51	42	3
Japan, 1950	3	74	19	3
United Kingdom, 1951	76		18	—
United States, 1960	4	34	57	5
Auto mechanics				
Canada, 1951	4	51	41	3
Japan, 1950	1	66	29	4
United Kingdom, 1951	68		25	—
United States, 1960	4	36	55	4
Weavers				
Canada, 1951	4	67	26	2
Japan, 1960	4	74	20	1
United Kingdom, 1951	84		9	1
United States, 1960	10	51	39	1
Tailors and dressmakers				
Canada, 1951	7	52	38	3
Japan, 1960	4	59	35	3
United Kingdom, 1951	70		19	—
United States, 1960	17	49	31	4
Cabinet makers				
Canada, 1951	6	50	40	4
Japan, 1950	7	75	17	1
United Kingdom, 1951	70		22	—
United States, 1960	5	36	51	7

	Years of schooling			
	0–4	5–8	9–12	13+
Compositors and typesetters				
Canada, 1951	—	29	63	7
Japan, 1950	3	69	28	2
United Kingdom, 1951		71	23	1
United States, 1960	1	18	69	10
Molders and coremakers				
Canada, 1951	8	57	32	3
Japan, 1950	5	76	17	2
United Kingdom, 1951		85	8	—
United States, 1960	9	46	52	3
Carpenters and joiners				
Canada, 1951	11	59	28	2
Japan, 1950	8	80	12	1
United Kingdom, 1951		75	19	—
United States, 1960	7	41	47	5

ANNEX III

An input–output model including skill requirements

If we assume a country with three sectors and three types of skills (this example can be expanded easily to n sectors and m skills) we may write:

$$X_1 = a_{11}X_1 + a_{12}X_2 + a_{13}X_3 + X_{1D} = a_{11}X_1 + a_{21}X_1 + a_{31}X_1 + rK_1 + S_{11}w_1 + S_{21}w_2 + S_{31}w_3 \qquad (1)$$

Where X_1 is the production of industry 1,

X_{1D} is the final demand for the product of industry 1,

S_{11} is the number of people in occupation 1 employed in industry 1,

r is the rate of return per unit of capital, for all sectors,

K_1 is the amount of capital in industry 1,

w_1 is the wage paid for skill 1, and

a_{12} is the interindustry coefficient.

Regrouping (1) we have

$$X_1(a_{21} + a_{31}) = a_{12}X_2 + a_{13}X_3 + X_{1D} - rK_1 - (S_{11}w_1 + S_{21}w_2 + S_{31}w_3) \qquad (2)$$

Dividing and multiplying certain terms by L_1, the number of people employed in industry 1, we have

$$X_1/L_1(a_{21}+a_{31})L_1 = a_{12}X_2 + a_{13}X_3 + X_{1D} - rK_1 - L_1(S_{11}w_1/L_1 + S_{21}w_2/L_1 + S_{31}w_3/L_1) \qquad (3)$$

where $X_1/L_1 = P_1$ is the productivity of labour in industry 1, and $s_{21} = S_{21}/L_1$ = percentage of occupation 2 in the labour force of industry 1; we now can write the whole system as follows:

$$\begin{aligned}
&P_1(a_{21} + a_{31})L_1 - a_{12}X_2 - a_{13}X_3 - rK_1 + L_1(s_{11}w_1 + s_{21}w_2) &&= X_{1D}\\
&\left[P_1(a_{21} + a_{31}) + s_{11}w_1 + s_{21}w_2 + s_{31}w_3\right]L_1 - a_{12}X_2 - a_{13}X_3 + rK_1 &&= X_{1D}\\
&\left[P_2(a_{12} + a_{32}) + s_{12}w_1 + s_{22} + w_2 + s_{32}w_3\right]L_2 - a_{21}X_1 - a_{23}X_3 + rK_2 &&= X_{2D}\\
&\left[P_3(a_{13} + a_{23}) + s_{13}w_1 + s_{23}w_2 + s_{33}w_3\right]L_3 - a_{31}X_1 - a_{32}X_2 + rK_3 &&= X_{3D}
\end{aligned} \qquad (4)$$

Also

$$\begin{aligned}
L_1s_{11} + L_2s_{12} + L_3s_{13} &= \bar{S}_1\\
L_1s_{21} + L_2s_{22} + L_3s_{23} &= \bar{S}_2\\
L_1s_{31} + L_2s_{32} + L_3s_{33} &= \bar{S}_3
\end{aligned}$$

where $\bar{S}_1$, $\bar{S}_2$, $\bar{S}_3$ are number of available people with occupations 1, 2, 3.

Assumptions 2 and 3 stated above, can now be introduced, namely, P_1 is a function of the occupational composition of industry 1; K_1 is a function of the occupational composition of industry 1. We also assume that X_{1D} is a function of X_1 or a given parameter, and occupational wage rates and interindustry coefficients are given.

We therefore have n industry equations and m occupational equations, and total number of equations is $n + m$, and the total number of unknown variables is 2_n (n L's and n X's) if m (the number of occupations) is less than n (number of industries) we can introduce $n - m$ constraints. One of these constraints could be the maximization of $X_1 + X_2 + X_3$ = total production.

Consultative Group Meetings on Industrial Estates and Industrial Areas

A CONSULTATIVE GROUP on industrial estates and industrial areas for certain European and other countries in the process of industrialization met in Geneva, Switzerland, from 24 to 29 October 1966. A consultative group on the same subject, for the Arab countries of the Middle East, met in Beirut, Lebanon, from 31 October to 5 November 1966.[1] These meetings were sponsored by the Centre for Industrial Development[2] and the Bureau of Technical Assistance Operations[3] of the United Nations Department of Economic and Social Affairs, in co-operation with the Economic Commission for Europe (for the Geneva meeting) and the United Nations Economic and Social Office in Beirut (for the Beirut meeting) respectively. The Geneva meeting was attended by fifteen participants from ten countries, by staff members and consultants of the Centre for Industrial Development and by representatives of the Economic Commission for Europe, the International Labour Organisation, the Food and Agriculture Organization of the United Nations and the European Economic Community. The Beirut meeting was attended by eleven participants from six countries, by staff members and consultants of the Centre for Industrial Development and the United Nations Economic and Social Office in Beirut and by representatives of the International Labour Organisation and the Food and Agriculture Organization of the United Nations.

Both consultative groups discussed the following subjects with special reference to promotion of small-scale industries: the role of industrial estates and industrial areas in development policies and programmes; planning of industrial estates and industrial areas; organization and management; services and facilities; financing of industrial estates and industrial areas; and international and regional co-operation in the development of industrial estates and industrial areas.[4]

At both meetings a number of common conclusions were reached. As industrial estates are promotional devices and as in developing countries private, institutional and community organizations usually lack the means and experience to organize and finance industrial activities, the initiative and responsibility for setting up the first industrial estates should be taken by the Government or by a government-supported agency. Industrial estates would be effective only if they integrated all or most measures of promoting and assisting small-scale industries, and if, in turn, industrial estate projects were incorporated in broader development programmes. As only a small percentage of industrial enterprises could be accommodated on industrial estates and areas, one of the major functions of the latter was to act as a catalyst on industrial and economic development within a broad area. Careful selection of location was necessary, in particular as regards the first industrial estate

[1] These two meetings were the third and the fourth of the series of regional conferences on industrial estates sponsored by the United Nations. The first seminar, covering Asia and the Far East and organized in co-operation with the Economic Commission for Asia and the Far East (ECAFE), was held in Madras, India, from 1 to 11 November 1961. The Report of the ECAFE seminar and large excerpts of the discussion and information papers submitted to it were published in United Nations, *Industrial Estates in Asia and the Far East* (Sales No.: 62.II.B.5). A summary of the report was published in the fifth issue of the *Bulletin* (Sales No.: 62.II.B.1). The second seminar, for Africa, organized in co-operation with the Economic Commission for Africa (ECA), was held in Addis Ababa, Ethiopia, from 14 to 21 November 1964. The report of the ECA seminar and some of the discussion and information papers were published in United Nations, *Industrial Estates in Africa* (Sales No.: 66.II.B.2). A summary of the report was published in the ninth issue of the *Bulletin* (Sales No.: 65.II.B.6). A seminar on small-scale industry—which included a discussion of industrial estates and industrial areas—in Latin America was held, in co-operation with the Economic Commission for Latin America, at Quito, Ecuador, from 28 November to 3 October 1966. The report of the seminar will be published by the United Nations in 1968.

[2] Now the United Nations Industrial Development Organization (UNIDO).

[3] Now the Office of Technical Co-operation (OTC).

[4] At both meetings the discussion related not only to industrial estates for small-scale industries, but also to industrial areas for industries of all types and sizes and other industrial development projects in which the provision of physical facilities and related services were an essential element. The following definitions were accepted: The "industrial estate" is a planned clustering of industrial enterprises offering standard factory buildings, erected in advance of demand, and a variety of services and facilities to the occupants; as a rule, the estate would serve principally to promote small-scale industries. The "industrial area" offers only improved sites as an inducement to the establishment of industries of all types and sizes. The "industrial zone" is a part of an urban or suburban centre restricted to industrial use, on which no improvements are made. Both estates and areas should be located in industrial zones, and, if necessary, sub-zoned for industries of different types.

which was expected to have an important demonstration effect.

Each group recommended that the reports and publications of the Centre for Industrial Development be studied by the competent ministries and other agencies of the various countries, and noted that most of the countries had not availed themselves of the assistance provided by the United Nations under its various programmes, including the recently created programme of Special Industrial Services, in the field of small industry development and industrial estates. The Governments should review their needs for assistance and formulate requests for technical co-operation in consultation with the Resident Representatives of the United Nations Development Programme in the respective countries and, if required, with staff members and advisers of the United Nations Industrial Development Organization and United Nations regional commissions and offices.

Conclusions and recommendations of the Geneva consultative group

The role of industrial estates and industrial areas in development policies and programmes, with special reference to promotion of small-scale industries

The group agreed that the primary objectives in establishing industrial estates and industrial areas in developing countries were the stimulation of entrepreneurship and the promotion of industrial development. Small-scale industries had an important role to play in any programme of industrial development, especially in mobilizing latent resources, economizing capital, meeting local demands, making possible rapid increases in production and employment, and undertaking certain operations as sub-contractors of large-scale enterprises. In order to remedy their inherent handicaps and weaknesses, small-scale industries required special measures of assistance at all stages of establishment and operation. The industrial estate, which made possible the integration of all or most measures of assistance, was one of the most effective tools for the promotion of small-scale industries.

Industrial estates were intended to promote small-scale industries rather than handicraft and artisans' undertakings. The latter required different forms of assistance as regards processes of production, design of products, marketing, training and so on. A variation of the industrial estate—the workshop block with certain common service facilities—could be used for this purpose. In general, however, there was little opportunity in the countries of the participants for the establishment of such workshop blocks; common service facilities could be provided independent of workshop blocks in localities with large concentrations of artisans. As regards small jobbing enterprises and service industries, scattered locations were in general preferable to concentration on common sites

Industrial areas were devised mainly for attracting large-scale and medium-sized industries. As a rule, these industries did not require standard factories and special measures of assistance, with the exception of foreign industries for which the immediate availability of a large factory building and the availability of assistance in hiring and training labour, in making market studies, and in carrying out incorporation and other formalities, were sometimes an appreciable inducement. Experience showed that the offer of an improved site in an industrial area was not in itself a sufficient inducement for establishing large-scale or medium-sized industries many countries placed great reliance on other incentives such as fiscal and customs concessions. There was abundant evidence, however, of the effectiveness of global programmes, including industrial areas. A particularly useful element in such programmes was the construction of factories by the sponsoring authority of an industrial area and sometimes even the provision of equipment on a "turn-key" basis for known occupants. In certain regions the provision of additional inducements, such as lower rents or sale prices for plots or standard factories, favourable credit terms and generous tax and customs incentives, would be justified. The group felt, however, that locations requiring extraordinary inducements should be avoided.

The steering of industry towards less-developed regions should be accompanied, and often preceded, by other related, infra-structural measures: training and retraining programmes; development of related sectors—agriculture, irrigation, transportation, tourism, etc.; and investment in social overheads. Appropriate locations for industrial estates and industrial areas in less-developed regions should be carefully selected on the basis of economic and technical criteria. Wherever possible, the features of the industrial estate and the industrial area should be combined. Especially in urban and suburban areas, an industrial estate and an industrial area should be located on the same tract of land within a properly planned industrial zone. Among other benefits, this would facilitate the establishment of complementary relationships among occupants, in particular of sub-contracting between large and small industries. In planning the expansion of existing cities and towns and the establishment of new towns, industrial estates, areas and zones could be effectively utilized to provide the necessary industrial base for development and growth.

As regards the role of industrial estates and industrial areas in attracting foreign capital, technical know-how and entrepreneurship, the group observed that although the paramount objective in establishing industrial estates and areas was not to attract industry from abroad, experience had indicated that the availability of suitable industrial sites and often of pre-built or custom-built factory accommodation was a useful complement to fiscal and financial incentives and other legislative measures for attracting foreign capital. Industrial estates located near a port or airport would be suitable for export industries, for industries processing resources hitherto exported raw or semi-processed, for industries processing imported raw materials and assembling imported components, for *entrepôt* activities, and for many industries catering for the domestic market.

In the developing, centrally planned economies of East European countries, small manufacturing represented a sizable proportion of the total number of industrial enterprises and of total employment in manufacturing. In these economies, small-scale industries were confronted with difficulties similar to those prevailing in market-oriented economies and needed technical, managerial, marketing and financial assistance. In some countries the grouping of small enterprises, both in associations and/or on common sites, was necessary to strengthen and assist them. In these economies small-scale industries also played a role in the decentralization of industry and in regional development. Co-operative industrial estates might be particularly useful if set up in conjunction with large industrial auxiliary relationships and recommendations were made that these possibilities be studied by the planning agencies of these countries.

Planning of industrial estates and industrial areas

The need was stressed for adequate pre-project planning of industrial area and industrial estate projects, taking into account the economic, engineering and physical factors involved. Surveys and feasibility studies should be undertaken to determine the most suitable locations; the types of industries to be promoted; the size of areas or estates; the size, number and types of factories and other buildings; the services and facilities to be provided; the costs of the projects; and the sources of financing and the phasing of development. A feasibility study should be based on an orderly, systematic investigation of the resources and markets of the area and on an analysis of the comparative advantages or disadvantages for each potential industry as related to alternative sources of product supply. A study should be carried out on the techno-economic aspects of each industry and recommendations should be made as to which industries are feasible and desirable and to the types of services, facilities and promotional measures they require. Such studies and surveys should be carried out on a continuing basis by each country agency responsible for industrial development or by a specialized agency set up for this purpose. In view of the shortage of skilled personnel in many developing countries, requests from Governments for United Nations Technical Assistance in these fields would be justified.

Noting the problem of continuously increasing urban land values and the scarcity of suitable land for location of industries, the Group recommended that in order to avoid land speculation, governmental or municipal authorities should acquire sufficient land well in advance of the final decision to set up industrial areas or industrial estates. Governmental authorities should consider using the system of the industrial land bank, under which an industrial or urban planning agency continuously acquires, reserves, sub-divides, sells or leases land in various locations for industrial use.

Non-specialized industrial estates for all types of small-scale and light manufacturing industries were generally the most suitable for promotion of industrial development. There was limited scope for establishing functional, ancillary and other specialized estates. In establishing such estates, particular attention should be paid to the distribution of production functions among the occupants, the organization of marketing and the provision of common service facilities. In general, industrial estates with single-storeyed factory buildings were favoured, on account of lower costs, greater convenience for operation and possibilities of expansion. In planning car parking, transportation and housing facilities, future needs should be taken into account and estate planning integrated with over-all urban planning.

Advance factories ready for immediate occupation were considered a major attraction to national *entrepreneurs* as well as foreign investors. Their construction should be planned on the basis of the rate of annual demand, building time needed, building costs and the purpose of the estate. As for the design of standard factories, no rules could be established for areas of factory units, as these should be chosen to match the types of industry to be accommodated. Whatever the initial area selected, provision should be made for future expansion by at least 100 per cent. It was agreed that standardization of components was highly desirable because of reduced costs and possibilities of prefabrication. The group endorsed a number of planning ratios relating to the proportion of roads to total area, employees per acre or hectare, power requirements for factories of different sizes and so on.

Organization and management

While recognizing the pivotal role of the Government, the group cautioned against a policy or programme that would result in too great a dependence of industrial enterprises on government assistance which would be detrimental to self-supporting growth. At the same time, some participants felt that their Governments should do more to stimulate entrepreneurship and assist small-scale industries. A cumbersome government apparatus, however, with a multiplicity of departments or agencies responsible for industrial-estate development should be avoided. The group recommended the establishment of autonomous or semi-autonomous agencies for industrial estate projects, the association of representatives of *entrepreneurs* and occupants in the management, and, eventually, the encouragement of local and private initiative for undertaking such projects. It was stressed that industrial-estate and industrial-area development was much more than real-estate development and that complementary promotion measures and services should be provided.

Admission policies should be governed by the priorities prescribed in national and regional plans. In the countries of the participants, priority of admission generally was given to employment-creating enterprises, export-oriented industries and industries tending to modernize and creating large added-value by manufacture. Apart from the type of industry, the type of *entrepreneur* to be admitted should be

Technician checks gauges of a distillation tower at a computer site in San Jose, California, U.S.A.

A cement plant at Acajulta, El Salvador

carefully selected. Admission policies in regard to foreign industry should be liberal in countries promoting foreign investment, but a policy of preferential incentives to foreign enterprises vis-à-vis indigenous enterprises was not favoured. The dissemination of detailed information on the facilities available on industrial estates and areas should be supplemented for small-scale industries by "model schemes" or "industry fact sheets" providing data on the technical and economic requirements of individual industries. These would help in attracting national and foreign capital and entrepreneurship.

As regards sales and lease policies, the best arrangement would generally be to lease the factory buildings for a period of up to five years, and to provide an option to the occupant for outright purchase or purchase on an instalment payment basis. While initial subsidization of rent was an incentive to rapid occupancy, especially for small-scale industries, such subsidization should not extend beyond a period of five years, after which an economic rent should be charged. The corporate character of the industrial estate or area should be maintained through provision in the lease agreement for control by the industrial-estate authority over the use of the land and buildings and over resale of the factory buildings. Control by the sponsoring authority should normally extend only to the administration of the estate or area and the enforcement of lease agreements, and not to the operation of individual enterprises. The degree of managerial control would necessarily be greater in a specialized industrial estate than in a non-specialized industrial estate. Without interfering with the operations of individual enterprises, the industrial-estate management could have a healthy influence on ensuring co-operation between enterprises in the estate.

Services and facilities

The industrial estate should serve as a focal point for the promotion of industrialization and not merely provide factory sites and buildings. The type and nature of services and facilities to be provided would depend on the objectives, the location and the composition of the estate and on the complementary programmes of other public or private agencies. Industrial-estate managements, like enlightened managements of large enterprises, should co-ordinate and ensure the availability of amenities such as catering facilities, fire and police protection, health and recreational facilities, but need not necessarily provide them themselves.

The availability of trained workers was as important for attracting entrepreneurship, including foreign enterprise, as for achieving high productivity and good quality of products. Close co-operation of the estate management with trade schools, vocational training centres, polytechnics and other institutions was recommended to facilitate the availability of training facilities. Occasionally training facilities in specialized fields of productivity and management should be organized by the industrial-estate management itself with the co-operation of the occupants and the neighbouring training institutions.

Advisory services, including guidance and assistance to the *entrepreneurs* and provision of information, were the most important promotional facilities of an industrial estate. While full development of these facilities was possible only on the large estates, some services could be provided on small estates by the estate manager and by visiting teams of extension workers. The group felt that most developing countries were in need of permanent, government-sponsored extension service institutions. Advisory centres set up on industrial estates should assist not only the occupants of the estates, but also industries located elsewhere.

Regarding common service facilities on industrial estates, it was noted that the bigger the estate, the more economic would be the provision of such services. While certain services, such as fire-fighting and refuse disposal, were essential in every estate, certain other services, such as common workshops and canteens, would depend upon the size of the estate, its location, the type of industries, the availability of outside services and other factors. Only those services for which there was sufficient demand, and which were not available on a commercial basis, should be provided by the industrial-estate authority. On most industrial estates for small-scale industries, a tool room with heat-treatment equipment, drawing and design office, and a testing laboratory preferably associated with the issue of standards and quality certification marking would be useful common service facilities. The industrial estate would frequently be a good location for a training centre which was part of a national or regional scheme; training could readily be supplemented by operational experience and the estate environment would be suitable. But the training service would not be confined to the estate. Other services might include a showroom for exhibiting the products of the enterprises, legal advice, insurance, accounting and auditing service. Commercial banks or public industrial banks could be offered space in large industrial estates. The provision of too many services free of cost, however, would be detrimental to the growth of self-reliant enterprises. While promotional and educational services should be provided free of charge, services which directly benefited an industrial enterprise should be charged at cost.

Financing of industrial estates and industrial areas

Because of the heavy investment and operational costs and of the promotional nature of industrial estates for small-scale industries, it was unlikely that private and institutional sources of financing would be available for their establishment. Financing would generally be provided by public or government-supported institutions. After the successful establishment of the first demonstration industrial estates by the central Government or by a public agency financed by the central Government, associations or co-operatives of *entrepreneurs* and chambers of commerce and industry should be encouraged and assisted to establish industrial estates, in co-operation with municipalities, local governments and urban planning authorities. Financing could be

undertaken through private and institutional organizations, the issue of municipal revenue bonds, loans from insurance funds, and so on, all of which could be provided under government or central bank guarantees. Financing of machinery and equipment and of working capital should be provided by institutional channels commercial and development banks and not directly by the Government or the industrial-estate authority.

The group noted that external financing from international institutions and from bilateral programmes had been available for some industrial estate projects. It recommended that the technical assistance work of the United Nations Industrial Development Organization (UNIDO) and the United Nations Development Programme (UNDP) in the field of industrial estates be co-ordinated with the work of international financing agencies.

Conclusions and recommendations of the Beirut consultative group

The role of industrial estates and industrial areas in development policies and programmes, with special reference to promotion of small-scale industries

The group observed that in the developing countries industrial estates and industrial areas were increasingly used, in conjunction with other measures, to attract industry and to regulate its location. Industrial estates had proved to be an effective instrument for stimulating local entrepreneurship; they facilitated the establishment of new small-scale industries and could induce the modernization, expansion and diversification of existing ones. Industrial areas contributed to attracting large-scale and medium-sized industries, both national and foreign. Besides helping in planning and regulating the growth of urban areas, industrial estates and areas could also be a useful component of urban renewal programmes. One of their most important roles was to contribute to industrial decentralization programmes by steering industries away from congested urban centres towards relatively less-developed regions. Industrial areas and estates were effective in promoting interindustry relations, in particular by encouraging subcontracting between large and small industries. They could usefully be linked to projects for the creation or expansion of ports and airports. Thus, industrial estates and industrial areas were flexible instruments which could be adapted to serve different industrialization policies and to meet a variety of local conditions and needs.

The group cautioned that the provision of physical facilities on industrial estates—improved sites, standard factories, common service workshops—important as it was, did not offer a complete solution to the problem of development of small-scale industry. *Entrepreneurs* should be provided with carefully prepared industrial feasibility studies and should be assisted in all formalities leading to the establishment of their enterprises. Financing on liberal terms should be available to supplement the resources of the small *entrepreneur*. Once established, the enterprises should be provided with assistance in solving their technical, managerial and marketing problems, and with information on industrial labour laws, fiscal benefits and obligations, and so on. The organization, financing and management of the estate itself, the incentive legislation, the organization of labour and management training, and the organization and financing of extension services should be part of a broader programme of development, which could be drawn up and implemented only by the Government. Similarly, industrial-area projects were effective in attracting large-scale and medium-sized industries only if they offered in addition to improved sites a variety of complementary measures and facilities.

In localities where there were prospects for the establishment of industries of all types and sizes, both an industrial area and an industrial estate should be located, if possible, on the same tract of land so as to achieve economies and to facilitate interfirm relations. Flexible land-use policies should be adopted on industrial estates, small industries being offered either standard factories, improved sites or, when necessary, custom-built factories.

The group felt that industrial development was of such importance to the economies of countries of the Middle East region that it required a greater involvement of the Governments concerned in particular in projects for the establishment of industrial estates and areas.

Planning of industrial estates and industrial areas

The group stressed the importance of undertaking industrial feasibility studies before planning the establishment of an industrial area or an industrial estate. This was necessary for determining the location, type and size of areas and estates, the infrastructure facilities required and the phasing of development. In the case of industrial estates for small-scale industries, such studies were essential for planning the number, type and size of standard factory buildings and of common service facilities.

In most countries of the region, over-all plans had been drawn up of industrial development allocating resources at the national level, but there was a need for detailed techno-economic studies to be undertaken at the sectoral and plant levels. Many types of small-scale industries could be set up on the basis of standard studies, sometimes called "industry fact sheets" or "model schemes". Such studies could be carried out by industrial development institutions and development banks. Adequate training programmes should be established to meet the shortage of personnel capable of conducting feasibility studies.

In the Middle East region the objective of industrial development had a higher priority than that of decongestion of urban areas and regional development. Industrial estate and area projects should be integrated with other development programmes related to power stations, irrigation schemes, new agricultural settlements, large industrial complexes and so on. Medium or small towns having market centres would be good prospects for industrial estate and area establishments provided that

other industrial feasibilities were met and that local government and local leaders offered their active support.

As for the types of industrial estates, there was little opportunity at this stage of the region's industrialization for the establishment of specialized industrial estates; estates for all types of small-scale and light industries would be the most suitable. In view of the importance of the artisan sector in most countries of the region, consideration might be given to the establishment of workshop blocks with a few common facilities in areas of concentration of certain trades.

Organization, management and financing

The group observed that governmental agencies responsible for areas and estates should, on the one hand, enjoy a large degree of autonomy to ensure operational flexibility and businesslike management and, on the other hand, be subject to policy control of government departments. Admission policies to industrial areas and industrial estates should be selective. High priority should be given to new industrial establishments that have potential for development, in particular to export-oriented or import-substituting industries. Modernization of equipment or expansion or diversification of production might be a condition for the relocation of existing industries. Factory buildings in industrial estates and areas should not be sold without the agreement of the estate authority in order to avoid their being used for non-manufacturing purposes. As most of the prospective *entrepreneurs* were likely to have limited financial resources, it would be advisable to lease buildings for a fixed period at the termination of which the occupants should have the option to purchase them either outright or on easy hire-purchase terms. Rent subsidization for a limited period and on a progressively diminishing scale was considered to be a desirable inducement to entrepreneurship and occupancy.

Some facilities on industrial estates and areas, such as power, water, gas and communications were essential to the existence of the occupants; other services like canteen, dispensary, police and fire protection were necessary for their welfare, safety and efficiency. Services and facilities necessary for improving the productivity of units and reducing their production costs included: (*a*) advisory services, e.g., training facilities, economic and technological extension services, research, technical information; (*b*) financial services, e.g., credit facilities, financial and cost accounting, insurance service; (*c*) technical services, e.g., tool room, testing laboratories, tool and equipment lease shops, maintenance workshops. Only those facilities should be provided which could not be set up by individual initiative or the joint efforts of the tenants. These facilities should be available to occupants as well as to enterprises located outside the estate or area. The minimum services to be provided from the very beginning would usually include testing and quality certification, tool room, maintenance shop and a good technical library service. While extension and advisory services should be provided free of cost to small-scale industries, common facility services of direct benefit to enterprises should be either charged at cost or subsidized (in the early stages). Close co-operation and collaboration with other agencies should be established for the setting up of training programmes and close working relations should be maintained between the agency providing extension services and financial and industrial research institutions. Although initially the central Government would have to finance the largest part of the capital expenditure of the estates, the co-operation of local bodies and public utility companies should be enlisted wherever possible.

Regional co-operation in the development of industrial estates and industrial areas

The group supported the recommendation of the Kuwait Conference on Industrial Development[5] that a Centre for Industrial Development for the Arab States be created. This Centre should include among its functions the provision of research, advisory and training services related to the promotion of small-scale industries. The importance of such a Centre justified the assistance of the United Nations Development Programme (Special Fund Sector). Until such time as a Centre began operations, there would be a great need in the region for intensifying industrial feasibility studies, for conducting research on small-scale industries as a factor of economic growth, and for promoting norms and standards regarding the establishment of industrial estates and areas. Through research and operational activities the United Nations and, in particular, the United Nations Economic and Social Office in Beirut should collaborate with the Governments concerned in the development of industrial estates and industrial areas.

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[5] Report of the Symposium on Industrial Development in Arab Countries, Recommendation No. 59, 60, United Nations Industrial Development Organization, Document No.ID/CONF.1/R.R.4.

UNIDO Ad Hoc *Meeting of Experts on the Role of Advanced Skills and Technologies in Industrial Development*

AN *Ad Hoc* Meeting of Experts on the Role of Advanced Skills and Technologies in Industrial Development was held at United Nations Headquarters in New York from 22 to 29 May 1967. The Meeting was organized by the Industrial Programming Section, Policies and Programming Division of the United Nations Industrial Development Organization (UNIDO), as one in a series of projects dealing with techniques of industrial planning and programming under the United Nations work programme on industrialization.[1]

The meeting was attended by the following international experts, participating in their individual capacity:

L. B. Cohen, Department of Industrial Engineering, Columbia University (United States);
George Cukor, Institute of Economics (Hungary);
Kazimierz Laski, Central School of Planning and Statistics (Poland);
Jirí Nekola, Institute for Science Planning (Czechoslovakia);
L. Riha, Institute for Science Planning (Czechoslovakia);
Carl Riskin, East Asian Institute, Columbia University (United States);
A. K. Sen, Delhi School of Economics (India);
Karl Shell, Massachusetts Institute of Technology (United States);
Zygmunt Slawinski, ECLA;
John Vaizey, Brunel University (United Kingdom);
Alexander Woroniak, Catholic University of America (United States);
Manuel Zymelman, Harvard University (United States).

Representatives and observers from the United Nations and other international bodies also participated in the meeting. Prof. A. K. Sen served as chairman. Rapporteurs were appointed for the main items under discussion. The report was adopted at the final meeting on 29 May 1967 and will be published as a United Nations publication.

The experts held twelve meetings; eleven discussion papers were distributed.[2] Discussion was directed to the following subject areas: (*a*) technology and skills; (*b*) choice of technology; (*c*) industrial manpower planning; and (*d*) policies for the adoption of advanced technologies. Some of the important conclusions and recommendations reached at the meeting are given below.

Technology and skills

The general question of the skill requirements of different levels of occupations and of various industrial sectors in the developing countries was explored in considerable depth. It was generally agreed that efforts must be made to provide developing countries with relevant information on this area in order to promote effective planning.

The group felt that continued study would be needed to assess, as it was not yet clear, whether the range of occupations and skills in advanced countries was appropriate to a developing country. In many countries, skilled manpower of the highest level was used wastefully because of the lack of middle-level skills. There was urgent need for expanded research into the specific needs of middle-level manpower and for investigation of the appropriate relationship between the provision of skills at different levels.

While the investigation of the appropriate sequence of investment decisions in the capital field was a fundamental part of development planning, problems of sequence which arose in the provision of high-level manpower were equally important. The development of skills far in advance of the development of the relevant industries had led to widespread emigration of highly qualified manpower from developing countries to the advanced countries. Unless this

[1] This programme of work was recommended by the Committee for Industrial Development at its Sixth Session and approved by the Economic and Social Council (*Official Records of the Economic and Social Council, Forty-first Session, Supplement No. 6*, E/4203, E/C.5/150, United Nations, New York, 1966).

[2] A list of papers is given in the annex at the end of this report. A volume containing some of the papers will be published in 1968 as a United Nations publication: *The Role of Advanced Skills and Technologies in Industrial Development* (*Industrial Planning and Programming Series No. 3*).

investment in human capital could be utilized through simultaneous development of the related industries, there would be a gross waste of economic and human resources.

Taking these considerations into account, the group recommended that UNIDO undertake the following tasks:

(*a*) To determine the minimum educational and training requirements essential to industrial occupations in the developing countries. To this end, the use of job evaluation data as a source of skill requirements should be subjected to investigation and testing;

(*b*) To compile occupational profiles of establishments in similar industries in different countries, with a view to ascertaining the relationship between the occupational mix and productivity;

(*c*) To conduct studies on the impact of international and foreign corporations on the manpower structure and the skill development in the less-developed countries;

(*d*) To investigate the possibility of determining skill requirements on the basis of specific industrial processes by industrial sectors, and requirements of skill, education and other factors affecting managerial and semi-managerial (e.g., foremen) manpower.

Choice of technology

Noting that in its most general sense the choice of techniques reflected the ability of the economy, given final output, to vary both the composition of final output and the processes of production, the participants were of the opinion that the choice of the techniques of production was one of the most important decisions which the developing economies had to make.

It was recommended that UNIDO undertake research in a selected number of developing countries to determine to what extent substitutions could be made among processes and final outputs in the various economies. Methods should be developed to estimate the future pattern of factor proportions; the comparative advantages of various systems could then be weighed so as to facilitate the choice of the most appropriate technique.

The group noted that efforts to find techniques consonant with the factor availabilities in developing countries have sometimes led to the promotion of inefficient techniques. Caution should therefore be exercised in the asesssment of such factors. Moreover, in industries where a choice of technologies exists, UNIDO should support efforts to determine which technical variants are most suitable to the conditions under which they are to be adopted. In the process of designing plants for developing countries, separate analysis should be made of the technologies relating to the core productive processes and of those of ancillary operations where the scope for factor substitution may be greater.

Taking into consideration the limited market of developing countries, it was felt that due account should be taken of economies of scale; in instances where these are significant, a higher degree of concentration might be preferable in the interest of efficiency. It was recognized that increased concentration of industry has often involved important economic abuses; appropriate policies should be developed to avoid such abuses. UNIDO should carry out research on the importance of economies of scale in various industries and make the results available to the developing countries.

In choosing techniques of production, the group felt that it was important to know how various techniques contribute to the spread of skills and attitudes conducive to economic growth. It recommended therefore that research be undertaken on the relationship between the choice of techniques and on-the-job skill formation and development. To obviate bottle-necks and to increase the development and application of skills and attitudes, it would be necessary to explore existing opportunities for the simultaneous use of alternative technical variants.

The Governments of the developing countries should be advised on appropriate fiscal policies with a view to encouraging the most desirable choice of techniques without losing sight of the fact that saving for capital formation is a desirable element of total output. UNIDO should assist in the technical evaluation of particular projects in developing countries and should continue its efforts to provide training in project planning and project evaluation for personnel in the developing countries.

Manpower planning

The participants observed that while a great deal of work has been done in a number of countries and by several international agencies on the forecasting of manpower and educational requirements for economic development, there has been some exaggeration of the need for formal education in industry, and of the resources which should be devoted to developing high-level manpower. While general education was necessary as a base for skill development, many skills could be acquired only through on-the-job training and practical experience.

It was felt that UNIDO should engage in research in several fields, taking into consideration wherever possible the problems of skill formation in a regional context.

The group of experts concluded its discussion of manpower planning by making the following recommendations:

(a) *Industrial manpower training*

(i) UNIDO should study the relationships between general education, on-the-job training, skills and productivity. Existing plans have tended to emphasize formal education and to place little or no emphasis on on-the-job training.

(ii) UNIDO should undertake to revise the existing methodologies and, when necessary, to develop proper criteria, processes and techniques for forecasting, planning and programming industrial manpower. These improved methodologies and criteria should then be made available to the manpower, experts and advisers of the developing countries.

(iii) UNIDO should undertake, on an international basis, a review of the training patterns for different occupations and skills, with a view to selecting those most appropriate for the respective developing countries.

(b) *Operational activities*

(i) UNIDO should collate, screen and evaluate available data to facilitate the preparation of manpower forecasts, plans and programmes with special emphasis on highly skilled and skilled industrial manpower.

(ii) Manpower planning and programming experts should be included in the industrial development missions organized and supported by UNIDO.

(iii) UNIDO should prepare a roster of experts and inform the developing countries of the possibility of receiving advisory services in the field of industrial manpower planning and programming.

(iv) *Ad hoc* working groups of international experts should be created by UNIDO to study the specific problems listed above.

(c) *Topics to be put forward by UNIDO for consideration of the Governments of developing countries*

(i) The development of industrial manpower plans and programmes dealing separately with short, medium and long-term programming aspects.

(ii) Increased international co-operation among developing countries in the field of manpower planning and programming.

(iii) International action for the creation of a detailed classification of skills based on the International Standard Classification of Occupations and, if necessary, its revision and modernization and for the facilitation of planning and international comparison of data.

Research and development planning

The expert group recognized that the adoption of advanced technologies in the manufacturing industries of developing countries posed a demand for research and development activities and skills. As at least in the initial stages research and development activities in the developing countries will be mainly oriented towards similar objectives, the following should be taken into consideration in the preparation of a research and development activities plan:

(*a*) Definition of the future orientation of research in relation to the expected pattern of industrial production development;

(*b*) Training of scientific workers;

(*c*) Setting of pre-conditions for the adaptation of the results of world science and technology to the conditions of the developing countries;

(*d*) Helping in particular cases to start up production in newly built plants and helping to train specialists for these plants;

(*e*) Concentrating the original research effort on the problems which arise from the specific conditions of the respective countries, as it was felt that the solutions to these problems were not sufficiently covered by international science.

In the field of research and development, a scientific programme should be evaluated in terms of its demand for high- and middle-level manpower, and in terms of the allocation of funds. An assessment should be made to determine the amount of funds necessary to cover the costs of local research and development and the costs of acquiring scientific results, information and discoveries from abroad.

As there may be substantial costs involved in the establishment of new institutes, the purchase of special devices (e.g., electronic computers, pilot plants and other experimental installations, laboratories) and other investments to ensure research and development, it was recommended that international co-operation should be developed through the establishment of common research institutes, common research teams, and other forms of bilateral and multilateral collaboration between developing countries, including joint capital investment in industrial ventures, and common licences and patent policies.

Policies for the adoption of advanced technologies

The group noted that owing to the existing educational structure and the limited availability of capital in the developing countries there was a great dependency on imported technology. Given the present magnitude of the rate of technological innovation in developed countries it could not be expected that this dependency would diminish in the foreseeable future. This conclusion is based in part on the observation that the development of an efficient manufacturing sector in developing countries requires the adoption of advanced technologies for the domestic and external markets. In practice, such technologies can be secured only from the highly industrialized countries which have developed these technologies in accordance with their own factor endowments and market scale. The process of the transfer of technology to developing countries should be viewed, however, in the light of the following limitations:

(*a*) Information on existing technologies is not readily available.

(*b*) The developing countries are generally lacking in experience in selecting and adapting available alternative technologies.

(*c*) Resources for research and development are limited, with the consequent under-utilization of high-level manpower.

(*d*) The developing countries are dependent on imported technology, which in turn creates dependency on imports of producer goods and technical services, resulting in rigidities in the external sector and contributing to the inappropriate utilization of human resources, especially engineers and scientists.

(*e*) In most developing countries the market is limited so that in a given industry there may be only one or a few efficient plants using modern advanced technologies.

The expert group made the following recommendations:

(*a*) In order to reduce the burden of imported technology on the individual developing countries, national and regional centres should be set up to conduct both basic and applied research. These centres should undertake the design and engineering aspects of specific industrial projects.

(*b*) As international private industrial investment plays an important role in providing advanced technology to developing countries, more information should be made available on the advantages of particular arrangements between donor and recipient industrial enterprises.

(*c*) Specified sums for research and development should be allocated by international financial institutions within their commitments for industrial projects.

(*d*) Developing countries should give serious consideration to the possibility of efficiently producing their own producer goods. UNIDO should render technical assistance in this field and carry out the necessary supporting research.

ANNEX

Documents presented to the *Ad Hoc* Meeting of Experts on the Role of Advanced Skills and Technologies in Industrial Development, Organized by the United Nations Industrial Development Organization (UNIDO), United Nations Headquarters, New York, 22 May to 29 May 1967

Working papers

ID/WG.3/R

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2. Aide-Mémoire
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Discussion papers

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1. "Investment Criteria in Developing Countries" *by* K. Laski
2. "Job Evaluation as a Source of Information about Skill Requirements" *by* L. B. Cohen
3. "Classification and Analysis of Industries Based on Know-How and Skills" *by* J. Timar
4. "Planning Methods for Skill Requirements and Productivity Change" *by* G. Cukor
5. "Planning and Programming Methods Used in the Czechoslovak Socialist Republic in Relating Scientific Research to Industrial Growth Targets" *by* J. Chvátal, J. Nekola, L. Riha and L. Tondl
6. "Local Industry and the Choice of Techniques in the Planning of Industrial Development in Mainland China" *by* C. Riskin
7. "Discussions on Choice of Technology: A Critical Survey" *by* A. K. Sen
8. "The Requirements and Training of Highly Skilled Manpower for Latin American Industrial Development" *by* Z. Slawinski
9. "Technology and Skills"* *by* J. Vaizey
10. "Productivity, Skills and Education in Manufacturing Industries" *by* M. Zymelman
11. Not issued.
12. "Business Organization and the Transfer of Technology: Experience of the Soviet Union" *by* A. Worobiak

Background papers

ID/WG.3/BP

1. "Technological Knowledge and Economic Growth" *by* K. Shell
2. "The Planning of the Scientific-Technical Development in the Czechoslovak Socialist Republic" *by* Schejbal and Riha

"The Role of Enterprise-to-Enterprise Arrangements in Supplying Financial, Managerial and Technological Needs of Industrial Enterprises in Developing Countries" (E/4038) *by the* United Nations Department of Economic and Social Affairs

"Financing of Economic Development: Promotion of Private Foreign Investment in Developing Countries" (E/4293) *by the* United Nations Department of Economic and Social Affairs

"Application of Science and Technology to Development. Arrangements for the Transfer of Operative Technology into Developing Countries" (E/4319) *by the* United Nations Department of Economic and Social Affairs

3. Selected bibliographical references *by the* Industrial Programming Section, UNIDO

* Document not distributed. Presented only at the meeting.

Expert Advisory Group Meeting on Industrial Investment Promotion

UNDER UNIDO SPONSORSHIP the Expert Advisory Group Meeting on Industrial Investment Promotion was held at United Nations Headquarters in New York on 26–27 June 1967. Participating in the meeting were representatives of investment promotion agencies established by developing countries in the United States, and officials from United States banks active in international investment, from United States governmental agencies engaged in investment promotion and from other interested organizations. The Chairman of the meeting was Mr. H. W. Singer, Director of the Policies and Programming Division UNIDO. The purposes of the meeting were:

To provide an opportunity for an exchange of ideas and experiences regarding present industrial investment promotion practices;

To examine more direct ways and methods of greatly increasing the level of foreign investment in developing countries;

To establish a basis of co-operation between private and governmental agencies engaged in industrial investment promotion;

To discuss the present and future scope of UNIDO's work in industrial investment promotion.

The meeting's programme was inaugurated by Mr. I. H. Abdel-Rahman, the Executive Director of UNIDO. In his opening address, Mr. Abdel-Rahman reviewed the procedures and requirements involved in successfully translating an industrial project into an industrial plant operation and called attention to the paramount requisites of choosing the project in relation to the over-all economy of the country. He stressed the fact that the project material should be carefully completed in all its aspects, underlined the responsibility of implementing a project by bringing together the investor and the project opportunity. Mr. Abdel-Rahman pointed out that greater energy and new techniques must be brought to bear on the problem of project implementation if the flow of funds was to approach even the minimum industrial growth requirements of the developing countries. The Executive Director of UNIDO also called attention to the Industrial Development Board's concern for this problem and to UNIDO's responsibilities and projected increased activity in this field. He added that even though UNIDO could not supply capital to developing nations, it could and would supply the means to mount an intensive campaign to bring potential investments in developing nations to the favourable attention of foreign industrialists and sources of finance. Finally, Mr. Abdel-Rahman stressed the importance of working closely with organizations and governmental agencies which are active in industrial investment promotion so that a greater and concentrated impact on this problem can be made.

The agenda for the meeting was drawn up with a view to encouraging discussion on the most crucial aspects of the investment promotion function from the initiation of the project to its implementation, including an evaluation of the internal facilities necessary for rendering assistance at the local level to the investor and the methods by which UNIDO could supply guidance, technical assistance, and training in order to establish such facilities. The subject material considered by the participants was as follows:

(*a*) Establishment of technical services for the identification of high-priority industrial investment opportunities;

(*b*) Evaluation of the effectiveness of present industrial investment promotion activities, including the role of investment promotion agencies in the developed countries;

(*c*) Establishment in the developing countries of an adequate legal and administrative structure to assist private foreign investment;

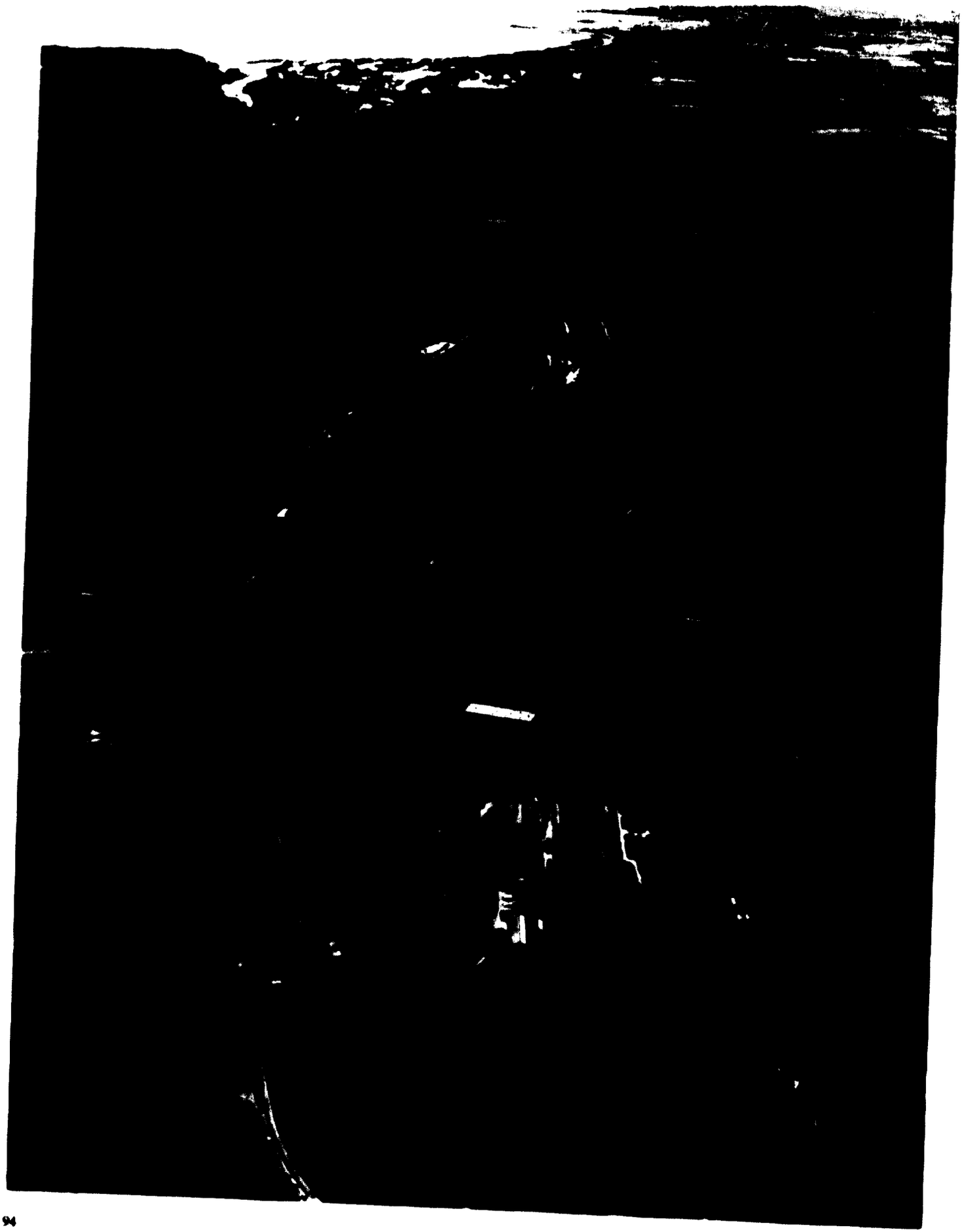
(*d*) Dissemination of information on the investment climate and opportunities in the developing countries;

(*e*) Establishment of investment promotion assistance units to help developing countries in the processing of investment;

(*f*) Identification of adequate sources of finance to ensure financing for sound high priority projects.

In the general discussion on over-all policies and techniques employed by developing countries in their promotion drive in the United States for attracting investments, the need was stressed for more personal contracts with the business community and for closer relationships with the major sources of financing.

One of the major obstacles to obtaining an increase in industrial investment in developing countries was the scarcity of soundly conceived and fully identified projects



Aerial view of the Bridgend Industrial Estate in South Wales, United Kingdom

The Hillington Industrial Estate in Scotland

capable of attracting potential investors. Attention was also drawn to the interrelation between governmental investment policies and the successful attraction of private foreign resources. UNIDO was urged to devote its efforts to the whole programme of project implementation. This programme would relate not only to assistance in seeking out interested investors in the developed countries, but also to guidance and technical aid regarding the establishment of the local facilities necessary for the development of sound projects and for the rendering of assistance to foreign investors in getting their project under way. In this connexion UNIDO should undertake, upon request of the developing countries, the training of investment promotion staff for carrying out investment promotion programmes at home and abroad.

One of the best ways to establish personal contact with regard to an investment project was through international banking organizations with considerable experience in finding prospective investors, often among their own clients. The United States commercial banks, actively engaged in international business, should be an important medium for advancing this personal contact, and UNIDO should avail itself of their facilities. These banking organizations, through their contacts in and out of New York City, could provide the various investment promotion agencies with personal introductions to interested parties in the United States and elsewhere. In this way projects whose existence might otherwise never have been known could be advanced with full data support for investment consideration. Moreover, a number of governmental organizations of the developed countries were also engaged in investment promotion. UNIDO should avail itself of these organizations for the benefit of the developing countries and co-ordinate its over-all efforts with those of the organizations.

It was noted that UNIDO had already embarked on a programme to bring to the attention of prospective United States investors outside the New York area information on investment opportunities in the developing countries by organizing, with the assistance of banking and governmental organizations, a series of meetings in various parts of the United States where representatives of the investment promotion agencies of the developing countries could meet with prospective investors and have an opportunity to explain first-hand the nature of project opportunities in their countries. Such meetings would also give the investment promotion officers of the developing countries exposure to large groups of prospective investors.

The expert group noted that existing work in the area of investment promotion had to be greatly expanded if the developing countries were to receive a greater flow of investment so essential to their industrialization. It recognized that further studies of investment promotion techniques were desirable and urged that further periodic meetings be held. It recommended that meanwhile UNIDO should serve the developing countries in the following ways:

(*a*) Provide advice to the developing countries as to what type of investment promotion agency for industrial development would be most effective, bearing in mind the particular conditions of each country. Such agencies could be located in the home country and directed primarily to domestic investors, or they could be located in capital-exporting countries to serve local industry and foreign investors.

(*b*) Provide assistance in the establishment of new industrial investment promotion agencies.

(*c*) Provide assistance to existing industrial investment promotion agencies of the developing countries with a view to strengthening them and to improving their operation.

(*d*) Advise developing countries or, more specifically, their industrial investment promotion agencies on the appropriate channels and procedures of reaching the proper sources of financing in capital-exporting countries for specified industrial projects.

(*e*) Establish contact between prospective investors in capital-exporting countries and promoters of industrial projects in developing countries who may be seeking foreign finance or know-how, or some other contribution in kind.

(*f*) Assist those developing countries which cannot afford the cost of operating investment promotion centres in capital-exporting countries to bring industrial investment opportunities, supported by feasibility studies or pre-feasibility evaluations, to the attention of prospective foreign investors.

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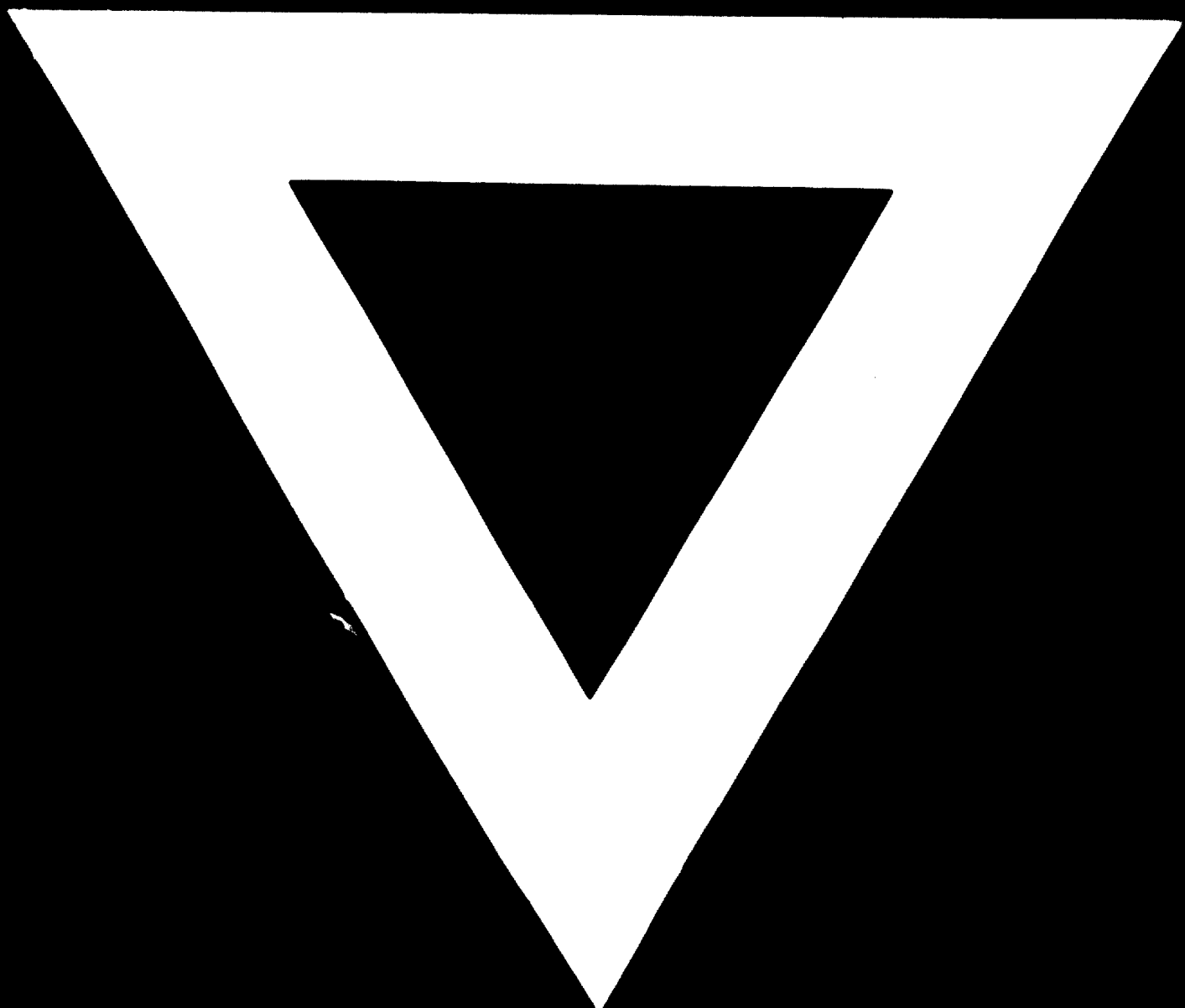

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