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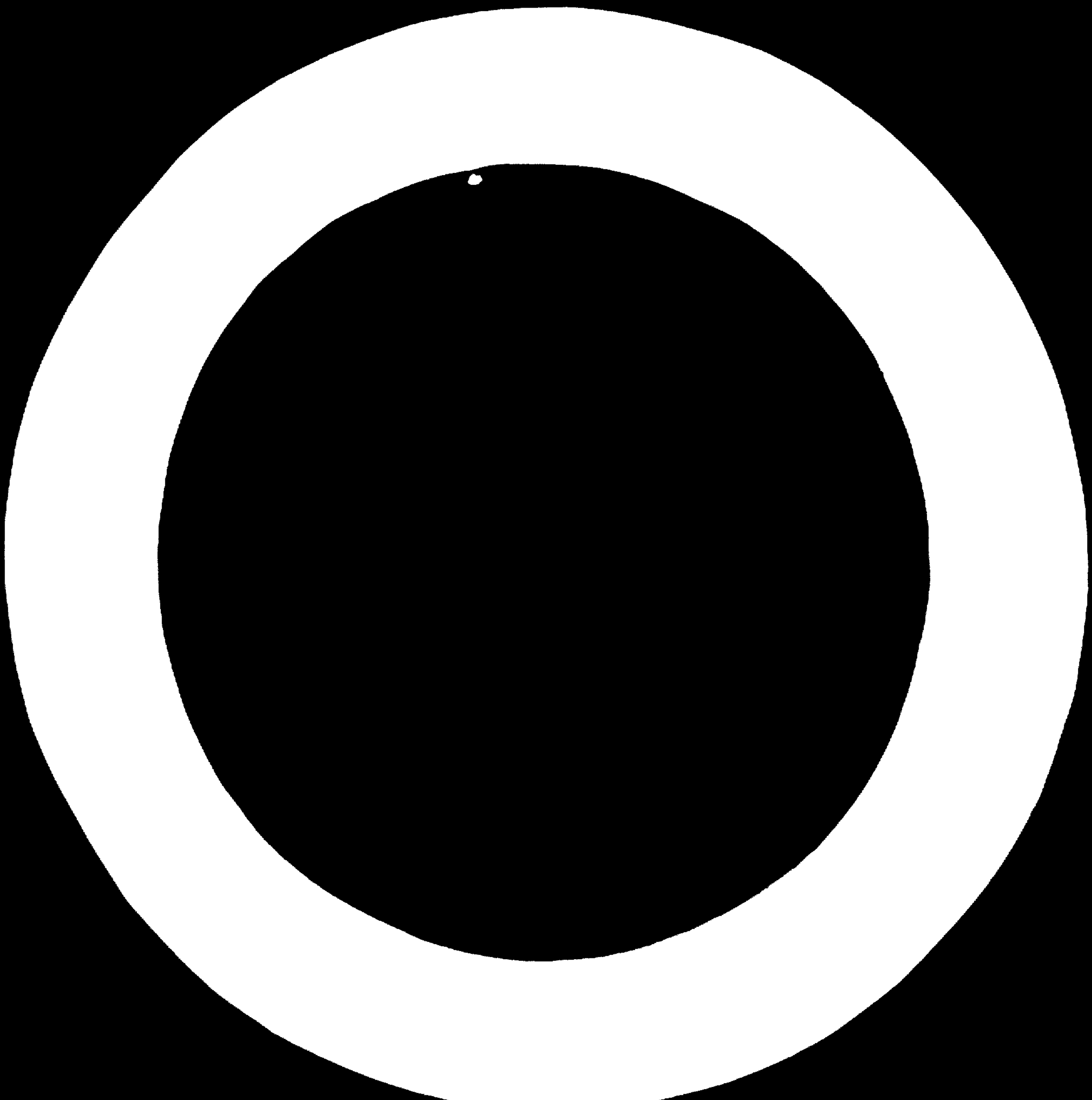
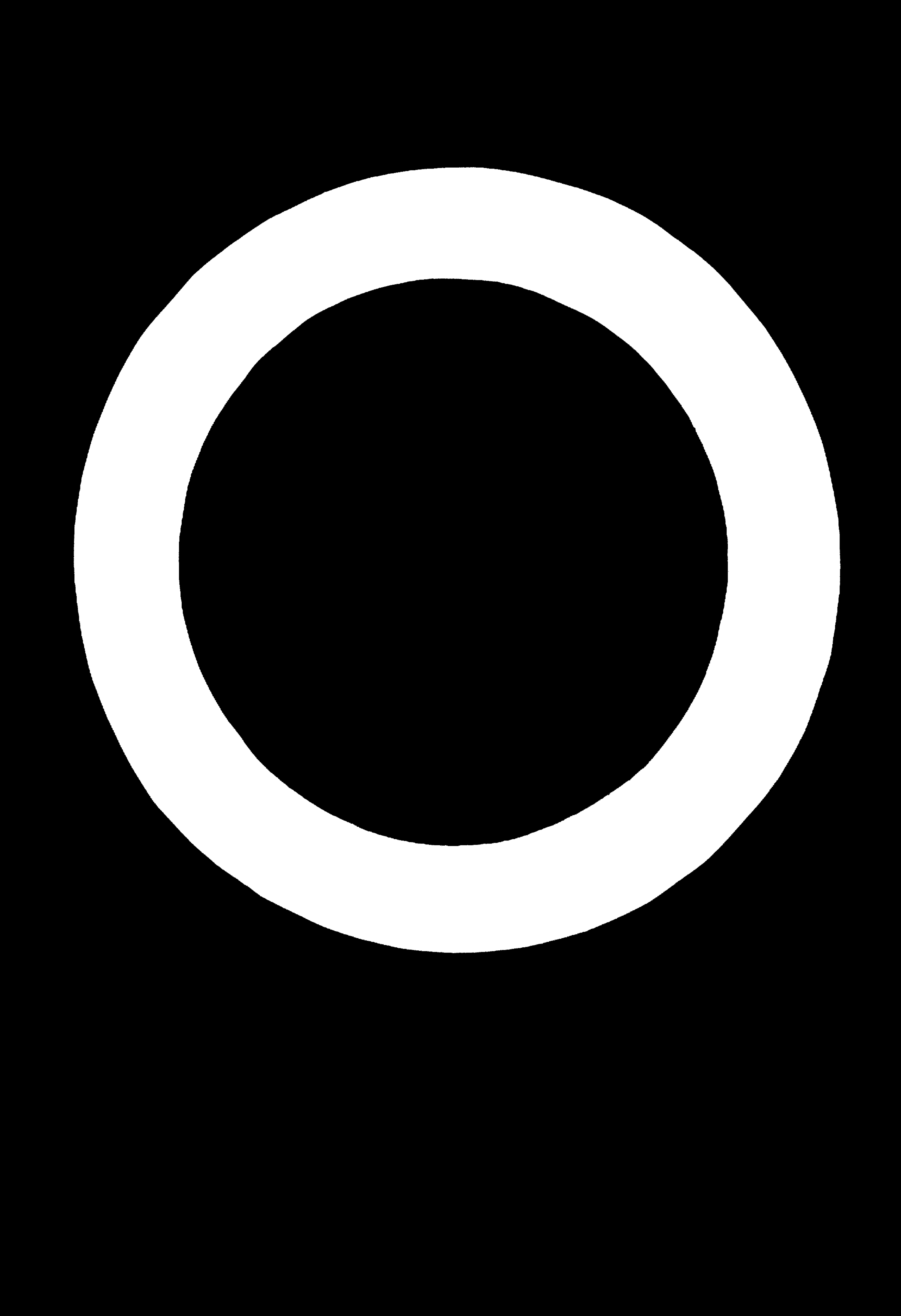
Industrial Research and Development News

VOL. VI No. 4

IRDN

UNITED NATIONS





UNIDO United Nations Industrial Development Organization, Vienna

Industrial Research and Development News

VOL. VI No. 4

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United Nations,
New York, 1973

ID/SER.B/18

UNITED NATIONS PUBLICATION
Price: **$U.S. 1.25** - Annual subscription **$U.S. 4.50**
(or equivalent in other currencies)

05078

By Constantine V. Vaitsos

Introduction

It is not possible within the scope of this article to present an exhaustive evaluation of all the issues relevant to licensing agreements. An attempt is made, however, to relate the subject in general terms to the needs of developing countries. Some empirical evidence is also provided from studies of the five Andean Pact countries. Finally, a brief description of the articles on know-how included in Decision No. 24 of the Commission of the Andean Common Market is given. This covers part of the orientation and instruments of policy governing the import of technology by the member countries.

An examination of the licensing system in itself, without explicit reference to underlying causal economic factors, business practices and legal requirements would tend to highlight various elements which might appear to be, *a priori*, arbitrary. For example, it may not appear immediately obvious why a parent corporation receives royalties from a subsidiary when the latter operates with lower corporate tax rates than those in the parent country and where no restrictions on profit remissions exist. Similarly, it may not appear obvious why a company charges non-affiliates different royalties for the same know-how. Questions may also be raised about the need to include export restrictive clauses in licensing contracts between a parent company and its subsidiaries when the same result can be achieved through control by ownership.

One example of how the licensing process, viewed apart from other elements in the economic and legal system within which it operates, can restrict an understanding of the underlying causal factors is the use of the term "technological balance of payments". This term represents the net balance of payments that results from incoming and outgoing foreign-exchange revenue derived from, respectively, the sale and purchase of know-how. The following example will assist in understanding the limited value this term has, unless it is placed within the broader context of business practice and government policy:

During a given year the subsidiary of a foreign company, in country X, pays royalties to its affiliate company, which has had especially high expenditures and to which, consequently, the parent company has temporarily sublicensed various patent rights. The following year the subsidiary in country X may need company funds for expansion purposes and, as a result, the payment of royalties may be dropped in order, perhaps, to take advantage of a low corporate tax rate granted locally. The succeeding years' royalties may be paid to the parent, or to an affiliate in some other country, for technology acquired by the subsidiary in country X several years before. The technology may, or may not, have been developed by the parent company, and its adaptation to country X may, or may not, have involved additional costs. Furthermore, the size of royalty payments may have been determined initially according to the needs of the parent company, or of one of its affiliates in another country, in order to set up, for example, marketing projects for products completely unrelated to those produced by the firm in country X. The net result for country X is called the "technological balance of payments".

Once the licensing system is placed within a context that incorporates *(a)* the over-all business strategy of firms, *(b)* the legal and regulatory requirements of Governments or the constraints imposed on business options through instruments of government policies, and *(c)* the need to maintain a certain degree of bargaining power in a situation where interdependence between licensor and licensee shifts continuously with time, then the terms and conditions of licensing adopt a fairly consistent pattern and contribute to the fulfilment of the objectives pursued.

Behaviour within the licensing model

Under certain market conditions, vendors of technology maximize their returns by taking advantage of the variations in demand for technology by applying discriminatory pricing policies. The diverse needs that exist among countries for a given technology, and the variations in the ability of firms to search, and negotiate, for it, allows the vendor of technology to sell the same know-how to several firms or countries and to make different claims on returns. The elasticity of demand for technology depends on many other factors not necessarily related to its importation. For example, the existence of protective tariffs that create differential returns in production could greatly affect the size of royalties that have been agreed upon in licensing agreements. Another factor that could affect the variations in demand is the store of information already available in a number of countries on the effects of such technology and on the options offered by substitutes. Developing countries which lack specialized knowledge

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in these matters may find themselves at a disadvantage, competitively, on the technology market. In the case of technology, what is needed is information about information, which is, in effect, one and the same thing. Thus, the prospective buyer is confronted with a structural weakness intrinsic in his position as purchaser and finds himself at a disadvantage in the corresponding market operations.

The use of information or technology by a company or individual does not reduce its availability. Thus, the cost involved in the use, or sale, of an already developed technology is close to zero for someone who already has access to it. In cases of adaptation (to scale, taste, local conditions etc.) additional costs are incurred, but these can be estimated. From the point of view of the prospective purchaser, however, the relevant incremental cost for developing an alternative technology within his own technological capacity might amount to a great deal. Depending upon market availabilities, it may range from very little to millions of dollars, being determined finally on the basis of crude bargaining power. The range of corresponding cost consideration is so wide that no fixed price can be claimed appropriate.

Technology in the process of commercialization is usually embodied in intermediate products, machinery and equipment, workers' skills, whole systems of production, even systems of distribution and marketing. Thus, know-how represents just a part of the whole commercialization process, its market constituting just part of the over-all market. This market integration of various inputs creates non-competitive conditions for each of them since they are sold in packaged form.

The terms of licensing agreements have to be understood within the context of diverse government policies and the way such policies differ between the country of the licensor and that of the licensee. One such policy refers to the tax structure that exists in both countries. For example, a subsidiary, operating in a country where corporate profit taxes are higher than those of the country of the parent company, will be induced to increase its payments of royalties to the parent company in order to capitalize on the net after-tax profits for the corporate system. Another government policy that affects royalty payments and the over-all terms of agreement in a licensing contract is geared to the tariff structure of the host country. Thus, high tariffs on products imported by a subsidiary from its parent company will induce, under certain conditions, the charging of prices lower than normal for such products in order to keep the tariff payments to a minimum. This lower product price may be compensated for by higher royalty payments to the parent company. Similarly, limits on profit remissions imposed by a host country will tend to induce the payment of higher royalties by subsidiaries in an attempt to bypass these government restrictions.

The above examples illustrate cases where terms of licensing agreements and payments for know-how sold were the direct result of government policies rather than strictly defined compensation for the contribution of technological inputs.

Another factor that affects the terms of licensing agreements is the over-all company strategy adopted by a transnational corporation when choosing a location for its production activities and the effect that this has on the country-reported company cost structures. Goods and services utilized by a subsidiary might have originated from one of its affiliates in another country, as a result of extra or inter-affiliate charges the cost structures of the corresponding firms might be affected. If such costs incurred by an affiliate, for activities directed towards the global operations of the corporation, exceed the revenue obtained from the sales in the local market or from non-affiliates abroad, it is advantageous to transfer returns through inter-affiliate charges. This will minimize tax payments in other units that may be reporting taxable profits and will, in turn, affect the terms of licensing agreements. Here, as in previous cases, company practices and clauses of licensing contracts not only depend on a strict and isolated evaluation of technological inputs but on an over-all company decision regarding the location of its production activities. In this case, firm strategy directed towards the minimization of global tax payments for the corporate system will influence the type of licensing agreements offered.

Terms of licensing may be further affected by the passage of time. The re-acquisition, at a future date, of information previously employed involves no additional cost since it has already been embodied in machines, processes and skills used in the past. This property of decreasing input cost over time generates conflicting interests and varying degrees of dependence upon both the supplier and the recipient of information since the value of the information to the latter depends strictly on the time when it is received and evaluated. Thus a licensor supplying technology may find himself in a deteriorating bargaining position due to time lost in possible re-negotiation. Initial terms may be set higher than the average expected to offer a margin for re-negotiation; or they may be arranged so as to avoid future re-negotiations.

An additional factor involved in the determination of contractual terms is legislation that defines the limits within which terms may be settled in private contracts. This legislation may involve industrial property, anti-monopoly or anti-trust policies etc. Many developed countries have created elaborate legal systems governing this matter and have had long experience of its applications and limitations. Many developing countries, however, do not have comparable legal instruments to protect the public interest and their absence may be reflected in the terms agreed upon between contracting parties.

The degree of market concentration is another factor that can affect the terms of agreement in a

Country	Sector	Percentage of total payments by the whole sector
Switzerland and United States of America	Food and beverages	96.6
United Kingdom of Great Britain and Northern Ireland	Tobacco	100.0
Federal Republic of Germany and Switzerland	Industrial chemicals	96.6
Federal Republic of Germany, Switzerland, and United States of America	Other chemicals	92.0
United States of America and United Kingdom of Great Britain and Northern Ireland	Petroleum and coal products	100.0
United States of America	Rubber products	99.9
United States of America	Non-metallic minerals	97.0
United States of America	Metallic products (except equipment)	94.0
United States of America	Non-electric machinery	98.7
Netherlands, Spain and United States of America	Electric equipment	92.0
France and Switzerland	Transport equipment	89.0

Figure 1.

licensing contract. This market concentration becomes particularly acute in technology-intensive industries, which generally demand heavy investment in fixed assets. For example, a survey carried out in Chile on foreign-owned subsidiaries having licensing contracts with their parent companies showed that 50 per cent had a monopoly or duopoly position in the host market; 36.4 per cent were operating in an ologopoly market where they held a leader's position; and only 13.6 per cent controlled about 25 per cent of the local market.[1]

Another form of market concentration refers to the very limited diversity of sources of supply of technology and capital that developing countries select in specific industries. Figure 1 above shows the percentage of royalties, profit remissions etc. recently paid out to foreign countries by Chilean licensors. The figures are based on an analysis of 399 contracts.[2]

The countries listed in the table show definite market destinations.

These forms of market concentration, and others related to them, certainly affect the terms of licensing agreements. The terms, which include payments for the technological contribution made to the licensee, are largely influenced by market conditions characterizing a given situation.

[1] CORFO, *"Comportamiento de las principales empresas industriales extranjeras acogidas a la TFI. 258"*, publicación No. 9 A/70 (Behaviour of the principal foreign industrial enterprises covered by TFI. 258, publication No. 9-A/70) (Santiago, Chile), p. 16.

[2] See G. Oxman, *"La balanza de pagos tecnológicos en Chile"* (The balance of technological payments in Chile) (September 1971).

Studies undertaken in the Andean Pact countries on technology licensing contracts

An analysis of 451 technology licensing contracts in the Andean Pact countries showed them to contain a number of major clauses.

Export restrictive clauses

One of the most frequent terms included in the contracts studied concerned export prohibition. Of the 451 contracts, 409 bore references to exports. Of these, 77 per cent explicitly prohibited exports from the technology recipient countries while others permitted exports only in well defined geographical areas. Contracts whose terms completely prohibited exports, as a percentage of the total number of contracts, were as follows:

	Percentage
Bolivia	77
Chile	72
Colombia	77
Ecuador	75
Peru	89

With the exception of Peru, whose figures were inflated by a large number of cases belonging to the pharmaceutical sector, the percentages were all in the seventies.

In terms of ownership structure, the following percentages were noted for the various forms of export restrictions (complete and partial):

	Percentage
Foreign-owned subsidiaries	79
Nationally owned firms	92

The percentage figure for foreign-owned subsidiaries is of limited significance since control through ownership can dictate export possibilities. The figure for nationally owned firms indicated that the contracts of 92 per cent of them restricted, in some way or another, the export of goods produced by foreign technology. This occurred at the time when the Andean Pact countries were trying to integrate their economies, following the establishment of their common market, by increasing inter-country trade. Agreements reached between governments in the case of technology commercialization are largely conditioned by the terms reached among private firms whose relative bargaining power is insignificant. Efforts made by the United Nations Conference on Trade and Development and individual Governments to achieve preferential treatment for the export of manufactured goods from developing countries have also to be considered within the context of the market structure which forbids such exports through explicitly restrictive clauses.[3] Technology, an indispensable prerequisite for industrial development, has become a major limiting factor in development due to its commercialization.

Tie-in clauses for intermediate products and their effects on import prices

A large percentage of the Andean Pact contracts studied included terms which explicitly designated the purchase of intermediates and capital goods from the same source as the know-how. Of the contracts studied in the chemical industry, and practically all of those in the pharmaceutical industry, 67 per cent included tie-in clauses.

Benefits for the licensor and costs for the licensee should therefore include not only explicit payments such as royalties but possible implicit charges in the various forms of margins from the concomitant or tied sale of other goods and services. In order to understand the possible magnitude of the effects of tie-in clauses in technology contracts, research was also undertaken in the Andean Pact countries on the f.o.b. prices of intermediate products imported by licensees. Over-pricing was defined as follows:

$$100 \times \frac{\text{f.o.b. prices on imports in Andean Pact countries} - \text{f.o.b. prices in different world markets}}{\text{f.o.b. prices in different world markets}}$$

In the Colombian pharmaceutical industry, the average over-pricing of products imported by 17 foreign-owned subsidiaries amounted to 155 per cent while that of national firms was 19 per cent. The absolute amount of over-pricing for the foreign firms studied came to six times the royalties, and twenty-four times the declared profits, of the licensees. For national firms it did not exceed one fifth of the declared profits.

Studies undertaken in Chile on 50 products indicated similar over-pricing. In Peru also, the imports of 22 pharmaceuticals firms indicated over-pricing ranging from 5 to 300 per cent. Over-pricing was also noted, although to a lesser degree, in other industries. For example, in the Colombian electronics industry, over-pricing of components for television sets and related products ranged from 6 to 69 per cent. In the same industry, in Ecuador, of 29 imported products 16 were imported at prices comparable to those of Colombia; 7 were over-priced up to 75 per cent; and 6 were, on average, over-priced by 200 per cent. Studies made in the Colombian rubber industry indicated average over-pricing of 40 per cent and in the chemical industry of about 25 per cent.

The balance of payments and fiscal charges resulting from such practices can be extremely important for countries importing technology. Extrapolating the figures given in the example for the Colombian pharmaceutical industry, which included 25 per cent of the imports of about 40 per cent of the industry, it can be deduced that foreign-exchange payments from Colombia, as a result of over-pricing in this sector alone, amounted to a figure comparable to the total royalties paid for technology by all industrial sectors in that country.

Other types of restrictive clauses

To understand the meaning and possibilities of a contract it must be thoroughly evaluated. Very often terms defined in clause A are conditioned or modified in clause B. Also, to avoid violating local legislation, ends may be achieved through indirect, but legally accepted, means. For example, the volume of production, or control sources of intermediates, can be affected indirectly through certain quality control clauses. Again, through control of the volume of production (which is permissible under certain patent legislations) the volume of exports (which is not permitted by the same legislations) can be controlled.

Restrictive clauses in contracts of technology commercialization vary. For example, in Bolivia, of 35 contracts analysed (in addition to the export restrictive and tie-in clauses mentioned above) 24 tied technical assistance to the usage of patents or trade marks and vice versa; 3 fixed prices of end products; 11 prohibited production or sale of similar products; 19 imposed

[3] Export restrictive practices have been observed by the Governments of Chile, Colombia, El Salvador, India, Iran, Kuwait, Mexico, the Philippines etc. in the purchase of foreign technology. See "Restrictive business practices" (TD/B/C.2/93, 30 December 1969), pp. 4–6.

secrecy on know-how during, and 16 following, the contract; 5 specified that any controversy or arbitrage should be settled in the court of the country of the licensor. Of the 35 cases, 28 also contractually made quality control the responsibility of the licensor. Similarly, in Chile, of 175 contracts 98 had clauses making the licensor responsible for quality control, 45 controlled the volume of sales, and 27 the volume of production. In Peru, of 89 contracts 66 contained clauses controlling the volume of sales of the licensee. Some clauses prohibited the sale of similar or identical products after the contract had ended. Others tied the sale of technology to the appointment of key personnel by the licensor.

The list of clauses included in technology commercialization contracts and the impact they have on business decisions prompt the question "what crucial policies are left under the control of the ownership or management of the recipient firm?". If the markets for, and volume, prices and quality of, what a firm sells, and the sources, prices and quality of its intermediates and capital goods, together with the key personnel to be hired and the type of technology used etc., are controlled by the licensor, then the only basic decision left to the licensee is whether or not to enter into an agreement to purchase technology. Technology thus becomes a control mechanism for the recipient firm. Such control supersedes, complements, or substitutes for the advantages of owning the capital of a firm. Political and economic doubts that have been voiced in Latin America concerning the high degree of foreign control in domestic industry can be properly evaluated not only within the foreign direct investment model but within the mechanism of technology commercialization.

Policies on technology commercialization included in Decision Number 24 of the Andean Pact[4]

In December 1970 the Commission of the Andean Pact, having considered the experience of the five member countries in purchasing foreign technology, established a series of policies which, through legislative procedures and institutional building, would regulate the mechanism for technology acquisition. These policies were presented jointly, and in accordance with the over-all philosophy on, and procedures for, direct foreign investment. Thus, the over-all direction of policies on technology cannot be adequately analysed without a concomitant understanding of the policies on foreign investment. For example, progressive national participation in the ownership of foreign subsidiaries operating in the Andean market will enable national investors to share in the use of foreign technology within the subregion. Ownership of a firm does not imply a non-functional enjoyment of its assets but control of, and profit in, and from, their use.

Similarly, the technological and foreign investment policies of the Andean Pact can be understood properly only if placed within the over-all economic formulations and objectives of Andean integration. For example, the scope offered by an enlarged market, fomented by special policies, affects the opportunities open to, and hence the bargaining power of, the Andean countries. This, in turn, results in the formulation of new policies on their part vis à vis the rest of the world. Equally, common planning by the five countries, for complementary industrial projects, affords the opportunity of collective bargaining with foreign investors and technology suppliers.

An evaluation of these broader economic issues and their underlying political bases would need much more space than it is afforded in this article. A brief analysis of the scope of the policies explicitly directed towards technology, however, can be given. The analysis is divided into the following parts: *(a)* Institutional structure for the importation of technology; *(b)* The management of technology commercialization; and *(c)* Complementary policies and programmes for the future.

(a) Institutional structure for the importation of technology

Article 6 of Decision No. 24 refers to the creation of competent government agencies which will regulate and execute all relevant policies concerning technology imports, together with the policies on foreign investment in each of the countries. In this sense, previous policies in Chile and Colombia, through which the respective Committees on Royalties were primarily directed towards balance of payments effects, will be enhanced to incorporate the much broader considerations related to technology commercialization and foreign investment. For Bolivia, Ecuador and Peru, Article 6 implies the creation of a completely new government organization which was absent before Decision No. 24 was approved.

These government agencies are authorized, through article 18, to evaluate and approve all contracts of technology commercialization and those related to the licensing of industrial property privileges (patents, trademarks, industrial models and designs etc.). Thus, Article 18 will enable the Government to strengthen and complement the bargaining power of the nationally owned firms by approving the access of foreign technology to the local market. Similarly, the Government will represent, in negotiations, the over-all national interests in cases of technology contracts between foreign-owned subsidiaries and their parent companies. In negotiations, as indicated by Article 19, imported technology will be itemized (production manuals, factory specifications, know-how, technical assistance etc.) so as to evaluate the contractual value of each, or groups, of them.

[4] "Transfer of technology: policies relating to technology of the countries of the Andean Pact: their foundations" (TD/107, 29 December 1971).

(b) The management of technology commercialization

The importation of intermediate products and capital goods in the commercialization of technology, and direct foreign investments, were identified as key elements in the existing industrialization programmes. As formulated in paragraph *(c)* of article 6, the Andean Pact countries will establish a control system that will attempt to keep the prices of such imports within a range close to that of the international market. By so doing, monopolistic structures, resulting from the joint transfer of products tied to technology and/or capital imports, will be regulated. These regulations, when applied to standardized imported products, will give nationally owned firms important bargaining powers by excluding prices of such imports from the negotiable category. For highly differentiated products lacking quotations in other markets, progressive national participation in the ownership of foreign companies could, through intra-company bargaining, achieve similar results.

Imported know-how, according to article 21, is compensated for by payment of royalties from nationally owned firms to their foreign licensors and by increasing the profitability of foreign-owned subsidiaries in the Andean countries. Capitalization of imported know-how, as such, is not permitted. Through this process Decision No. 24 restricts the denationalization of the ownership structure of local firms. In previous years such denationalization was achieved by the capitalization of know-how for which royalties were already heing paid. As far as foreign-owned subsidiaries were concerned, capitalization of know-how was leading, among other things, to domestic tax reductions through depreciation "charges" on intangibles and capital repatriation claims. Thus, in the latter case capitalization of technology constituted a depletion of the capital of the host country through repatriation of "investments" rather than a contribution to capital formation.

In addition, article 21 does not permit the payment of royalties from a subsidiary to its parent or affiliate companies. Such a policy, which is applied by various countries, is based on the principle that the effect of technological inputs in a foreign-owned subsidiary should be reflected in its locally declared profitability rather than in the tax structure of another country. Royalties among affiliated firms enjoy reduced taxation in the country of payment and could also achieve similar terms for the over-all system of a transnational corporation. Tax avoidance and the political issues that arise when an under-declaration of true profitahility is made are counter to the interests of countries hosts to foreign-owned subsidiaries.

To increase the amount of information available on the commercialization of technology, thereby enhancing the bargaining position of the recipient countries, article 49 establishes a permanent system for the exchange of information among the five Andean Pact countries on the terms and impact of technology purchase. This constitutes the first step towards applying the "most favoured nation" principle in the purchase of technology, which is directed at overcoming monopoly rents accruing from market segmentation within different elasticities of demand, unequal availability of information, and a variety of degrees of bargaining power on the part of recipient firms.

Articles 20 and 25 establish, for the first time in the Andean Pact, a legal base on which to deal with restrictive business practices resulting from the purchase of technology and the licensing of patents and trademarks. Export restrictions, tie-in arrangements, control of size and structure of production, personnel hiring, use of alternative technologies etc., are regulated by these articles. The absence of over-all and comprehensive anti-monopoly legislation, which results from inadequate analysis of the effects of monopoly and economic concentration in developing countries (whose market sizes are often conducive to monopoly), necessitates specific legislation directed towards restrictive business practices in the sale of technology.

Articles 26 and 54 contain regulations concerning industrial property. The inadequacy of the present patent system and the international agreements regulating it (the fundamentals of which were introduced in the last century when the circumstances and needs were completely different) indicate the need for a new approach. The interests of developing countries should be protected at least in their own legislation.

Finally, Article 51 establishes the important principle that any controversy or conflict in the purchase of technology or in foreign direct investment should be treated under the jurisdiction and competence of the national laws of the host country. (The importance of this position can also be evaluated in counter-proposals offered hy international organizations.) Article 51 treats, in addition, issues related to subrogation.

(c) Complementary policies and programmes for the future

Articles 22, 23 and 55 establish the mandate to approve a comprehensive legislative and institutional programme on technological policies by the Andean Pact countries. The object of such a programme is to relate policies on importation of technology with the development and encouragement of domestic technological activities. This implies the setting of priorities and the defining of types of projects related to diverse technological activities. Such activities will enjoy monetary and other direct incentives. There will be institutional requirements for a systematic and continuous search in the international market for alternative technologies, the establishment of information systems, aid to domestic efforts on technological development and the creation of an appropriate infrastructure to direct and promote related activites. Of major importance will be the effect of the development and use of technology on employment and on the exploitation of natural resources in the countries of the Andean Pact.

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CHANGING ATTITUDES AND PERSPECTIVES

By a UNIDO Staff member

Careful study of the experience of developing countries in recent years shows that certain basic changes are taking place in the approach of these countries to the licensing of foreign technology. The widespread fear of foreign economic domination, which marked the 1950s and the 1960s, has diminished appreciably; the role that foreign investment and technology can play in the industrial growth of developing countries is now generally recognized. At the same time, there is a definite trend towards greater economic independence, a trend that is reflected in the increasing number of regulations affecting the extent of foreign investment permitted in various industrial sectors.

Foreign investment and the inflow of technology

Traditionally, the inflow of technology to developing countries has been an integral part of direct foreign investment. Such investment was motivated by the need to find new markets to avoid tariff barriers and import restrictions, to exploit new sources of raw materials, or to take advantage of a low-cost labour supply. Many foreign corporations that invested capital in this way tended to operate through their own branches and subsidiaries, and often through their own marketing and distribution companies.

During the past decade, however, developing countries have become increasingly concerned about the cost of such investment, not only in terms of out-flow of profits and dividends, but in the form of royalties, know-how fees and payments for goods and components imported from parent companies. This concern has given rise in many developing countries to a feeling that ownership and control should rest with nationals as far as possible. This feeling is reflected in the growth of joint ventures with minority foreign participation. Foreign investment trends in the next decade will, therefore, increasingly be in the form of joint participation in local industrial enterprises, with greater selectivity being exercised by the developing countries that have achieved a high level of industrial development.

All these considerations may result in limiting foreign holdings in new projects or in a gradual reduction in the equity holdings of existing foreign subsidiaries.

In several developing countries, majority foreign ownership in new investments is not normally permitted. In India, for example, there is a list of industrial projects for which, though foreign technology would be welcome, no foreign capital participation is allowed. The countries of the Andean Group impose a considerable number of detailed restrictions on foreign investment, both new and existing. In the Philippines, majority foreign investment is allowed in certain "pioneer" industries for approximately twenty years, within which time it must be converted into a minority equity, unless the period is extended.

It is not the purpose of this article to consider the qualitative implications of foreign investment in developing countries: it is emphasized, however, that a country's policy with regard to such investment is bound to have considerable impact on the manner in which it acquires its foreign technology. When technology agreements are not linked to foreign investment, developing countries tend to exercise a higher degree of selectivity. For these countries, then, it is important to define how technology and know-how can best be acquired, absorbed and adapted to local conditions.

UNIDO's assistance with licensing

UNIDO is making great efforts to assist developing countries in establishing the conditions and institutional framework needed for the acquisition of foreign technology. More specifically, its assistance in this field is oriented towards the creation of a mechanism that would have both a regulatory and a promotional function in the procurement of foreign technology through licensing. In this context, UNIDO has been requested to assist in a case-by-case evaluation and scrutiny of proposed licence agreements.

A careful analysis of prevailing conditions and technological requirements is made in advance for each of UNIDO's technical assistance projects in this field. The spectrum of technological requirements naturally varies greatly from country to country, depending to a considerable extent on the stage and level of industrial growth.

Technological requirements

The technological requirements of developing countries generally involve the acquisition of composite or packaged technology. In industrialized countries, licensing agreements between enterprises are usually linked to the transfer of a specific know-how which assumes a high level of expertise on the part of the recipient. The scope and nature of the technological requirements of developing countries demand a much wider approach that extends far beyond the direct transfer of patented or unpatented know how. Accordingly, in the transfer of technology and know how to developing countries, various technical requirements for the establishment and operation of industrial enterprises should be taken into account. These include some or all of the following

- Pre-investment studies including preparation of a detailed project report
- Basic and detailed engineering including preparation of machinery specifications, plant design, factory layout etc.
- Selection of equipment, plant construction, erection and installation of machinery
- Process technology
- Technical assistance during the post-installation period, including training programmes and various forms of management assistance.

As the industrial and technological base widens in the developing countries and extends to an increasingly diversified range of manufacturing activities, the requirements for technical processes become more intricate and varied.

Objectives of technology transfer

By applying a comprehensive and well-oriented approach to the acquisition of foreign technology, developing countries can ensure that its inflow is adequate to meet their basic needs and direct it to cover major technological and production gaps. In addition, they can be more selective in the choice of technology and acquire it at reasonable cost and on acceptable terms and conditions.

At the same time, the degree of technological dependence of developing countries has to be gradually reduced. Greater efforts will have to be made towards adaptation and development of acquired technology as well as towards the establishment of local research and development activities.

To attain these goals, even partially, a co-ordinated approach must be adopted by Governments. It is their responsibility to design a policy framework sufficiently comprehensive to cover all aspects of the acquisition of foreign technology.

Comparatively few developing countries have considered this subject in detail. In most of them, the commercial considerations for the acquisition of foreign technology play a secondary role to policy issues relating to foreign investment or general contractual arrangements for the establishment of individual enterprises.

In many instances, licensing agreements are conducted on an enterprise-to-enterprise basis. The prospective licensee, anxious to obtain modern technology on favourable terms, is usually familiar with the market and its potential. Cost benefit analyses applied by local entrepreneurs, however, relate primarily to the economics of a particular enterprise, and the decision to conclude an agreement is usually based on an expected degree of profitability. It is important that wider socio-economic considerations than this be taken into account by the Government of a developing country before a licensing agreement is entered into.

This leads to a degree of regulatory control to ensure that the acquisition of a particular technology is in the overall interests of the national economy. Governments should therefore adopt a co-ordinated approach to the question in order to first identify certain technological gaps, and second to formulate a policy framework within which individual technology contracts can be negotiated. If the Governments of the developing countries are to carry out this task, they must define the type of institutional framework and mechanism best suited to deal with the acquisition of foreign technology through licensing. It is in this field that the assistance of UNIDO can be particularly effective.

Mechanism for regulatory control

Many developing countries have established institutions along the lines of a board of foreign investment to co-ordinate the acquisition of foreign technology. In other countries, however, there are no separate agencies for this purpose; proposals are channelled through the various government ministries. The advantage of having an institutional agency within the Government is that foreign proposals receive attention from a body empowered to formulate a basically uniform approach. The agency may be a semi-autonomous body with considerable power and authority, or a separate executive agency of the Government, with primary advisory functions.

The role of such an agency is both promotional and regulatory. On the promotional side, its responsibility includes

(a) Advising local entrepreneurs and domestic enterprises on foreign sources of technology;

(b) Identifying major technological gaps, taking into account the existing manufacturing techniques or goods for which local factor endowments are favourable;

(c) Advising local entrepreneurs and domestic enterprises on negotiating and drafting technology contracts and licensing agreements;

(d) Serving potential licensors and investors as a clearing house for information on opportunities for the establishment of local enterprises.

To carry out these functions, the agency needs a number of technical and expert personnel having detailed knowledge, and awareness, of growth and prospects in the various industrial sectors. The agency has to work in close co-operation with planning bodies in its own country in order to co-ordinate its activities.

One of its major roles is that of adviser on negotiations with foreign licensors and suppliers of technology. Although the agency provides advisory assistance to domestic enterprises on these matters, it is preferable that the actual negotiations be conducted by the enterprise concerned, and not by the agency, because of the practical difficulties involved when highly technical expertise in various industrial sectors is required. The main considerations of a licence agreement generally extend beyond the assessment and review of the payments involved. They include such important contractual features as aspects of technical assistance and restrictive and tie-in clauses which may be of particular concern to Governments.

Another important promotional function of the institutional agency is to provide a link between domestic industry and foreign industrial groups by keeping the latter informed of developments and licensing opportunities within the country. Many developing countries maintain investment centres in industrialized countries for the purpose of promoting trade and investment. Such centres could be even more useful if they were expanded to cover the flow of technology through licensing, and to provide a feedback of information on technological developments.

With regard to the regulatory function to be exercised in the transfer of technology, the specific approval of the Government or agency should be obtained before a contract is finalized. In some countries, prior approval is required for the release of foreign exchange for payments of royalties and know-how fees. In others, for example in those of the Andean Group, legal enactments insist on Government approval being obtained before any technology contract can be acted upon. In a number of developing countries, however, this question is neglected and little or no control is exercised.

Important features of technology agreements

Where there are considerable limitations on foreign exchange, the regulatory function should be exercised in such a way that the technology to be acquired is based largely on local inputs. From the developing country's point of view, the objective is to maximize local manufacture within the shortest period of time, and in some cases this aspect tends to be over-emphasized. However, foreign licensors should take into account the fact that the technology to be transferred should preferably be related to an increase in local manufacture. On numerous occasions, government officials have expressed concern about the unfavourable conditions they have to meet to obtain foreign technology and the limited possibilities of selecting technologies suitable for local needs and conditions. Furthermore, they are troubled by the various restrictive and tie-in clauses regarding manufacture or sales that are normally incorporated in licensing agreements; and by the quantum of payments. A number of developing countries have requested the advice and assistance of UNIDO on these matters.

Through detailed studies conducted in various developing countries, it has been found that a common restriction and perhaps the one most harmful to the economy prohibits, limits, or places conditions upon, the export of products manufactured under a licence agreement with a foreign company. A recent study conducted by the United Nations Conference on Trade and Development may be cited as an example.

In Mexico, 109 contracts covering the use of patents, trade marks and unpatented know-how were examined; 103 of them contained clauses limiting exports. In 53 of these cases, the restrictions took the form of absolute prohibition; in 13, prior export authorization was needed from the technology supplier; 12 had a provision that exports could only be effected through a given company; and 4 contracts had price-fixing provisions for exported products.

Similar situations have been found in many other developing countries studied by UNIDO.

Although it is difficult to ascertain the conditions under which exports should be permitted, or even to draw general guidelines for them, foreign licensors could adopt a more liberal approach with regard to the areas to which the licensee is allowed to export his products. There may be little practical relevance, for instance, in insisting on exclusive export sales rights to all countries for a sophisticated and highly technological product. A pragmatic approach in respect to non-exclusive sales rights for exports should be carefully considered as this would greatly add to the sense of freedom of both government authorities and licensees.

According to the tie-in clauses commonly incorporated in many contracts, the licensee is required to obtain some or all of his supplies from the licensor, or the licensee must undertake to buy from the licensor certain parts and components that are listed in the agreement. Where the licensor has reason to believe that the Government of the licensee may not permit a clause of this nature, as is the case in India, the agreement is formulated in such a way as to prescribe the general intention, with a separate supply contract for such items. In certain instances, the supply of particular components and intermediate products may become necessary when such products can be obtained only from the licensor. Although such cases are relatively rare, the licensee would be advised to incorporate a provision in the agreement for the continuous supply of these products for at least the duration of the agreement. With regard to the cost of such components and intermediate products, it may be desirable to obtain an agreement for specific prices at the time the contract is signed, allowing for fluctuations during its life.

Furthermore, the licensee would be advised to ensure that:

(*a*) The technology contract should include a provision that the cost of components and intermediates supplied by the licensor should be based on internationally competitive prices and that the manner of determining such prices should be carefully defined;

(b) The "most favoured licensee" clause should be incorporated in the agreement with regard to the pricing of components and intermediate products to be supplied by the licensor;

(c) Where the licensor supplies bought-out components and intermediate products, provision should be made for the price charged to the licensee to be the same as the price paid by the licensor, plus reasonable handling charges;

(d) In subcontracting arrangements where the licensor is the manufacturer of components and/or intermediate products, provision should be made to ensure that the price to be charged to the licensee for such products shall not be higher than the cost at which such items are entered in the books and accounts of the licensor at the next stage of production in his own plant. In such cases, the cost entries in the book of the licensor should be duly certified by the company's auditors and this information made available to the licensee.

By including these provisions in the agreement, the licensee may be able to obtain better prices for components or intermediates purchased directly from the licensor. He also protects himself by obtaining complete information on alternative sources of supply and international competitive prices, and, in principle, by avoiding tie-in clauses where there are alternatives.

Generally speaking, the question of remuneration and payment for technology is still determined jointly by the licensor and the licensee. There is a need, however, to formulate broad principles and guidelines governing such payments. The guidelines should touch on the basis for royalty computation; the percentage of royalty considered to be reasonable in the various sectors of industry, taking into account past domestic experience and the experience of other countries; and the relationship between technology payments and the extent of capital holdings in an enterprise.

The conditions under which technology is transferred vary so greatly that a flexible approach is necessary. For the relationship between payment for technology and the extent of foreign investment, only general principles can be laid down.

Conclusions

The developing countries' past experience with technology licensing will have a definite bearing on the future pattern of international licensing. Careful studies conducted by UNIDO and other United Nations organizations have shown that certain basic changes are taking place in the approach of developing countries to the licensing of foreign technology.

Although they are becoming increasingly aware of the role of foreign technology and investment, many developing countries are examining the implications involved in their acquisition much more thoroughly than in the past. The primary matters of concern to the developing countries are the issues that have an effect on their national economy.

It is important for foreign companies interested in licensing their technology to be aware of the significance of these changes and to understand the points of view of the developing countries. When potential licensors are aware of such issues, licence agreements are not only more practicable to enter into, but are also far easier to implement.

Although the flow of technology to developing countries can take place on an enterprise-to-enterprise basis, it still depends largely on the over-all climate and policy framework for foreign investment of the country concerned, on the one hand, and on the nature of the technical knowledge required, on the other. Transactions may be carried out through various forms of licensing arrangements, with or without capital participation, but the present trend for joint ventures in these countries is towards a contractual arrangement combining foreign investment and foreign technical know-how.

A market for technology that is protected by patents, trade marks or any other form of semi-monopolistic control, is far from ideal for the developing countries. The relatively weaker position of prospective licensees is accentuated by the composite nature of the technology that is normally required.

Government attitudes in the developing countries will be a further determining factor in licensing transactions in the years ahead. Institutional agencies may be created specifically to deal with this important question. UNIDO's efforts are geared to assisting the developing countries in the establishment of such agencies and to help them strike a balance between their regulatory and promotional functions. More specifically, the inflow of technology should be encouraged and promoted so as to cover the gaps existing in the technological field in developing countries.

The fact that selectivity is called for in respect to the nature and cost of such transfer should not detract from the basic principle that developing countries urgently need technological inflow, and that efforts should be made to facilitate such transactions. Furthermore, it is important that decisions on foreign proposals be made as quickly as possible. While it may not be advisable to allow unrestricted technology transfer, it is essential that proposals be scrutinized in the shortest time.

Imported know-how and technology obviously have an important role to play in accelerating the growth of the industrial sector in the developing countries; their successful transfer through licensing will be one of the determining factors in the realization of this growth.

HOW TO CORRECT POOR PRODUCTIVITY IN THE LATIN AMERICAN TEXTILE INDUSTRY

A UNIDO expert advises . . .

In spite of the low wages paid in the Latin American textile industry, the prices of textiles produced in this region are extremely high on both the international and the domestic markets. There are a number of reasons for this anomaly: the industry must purchase most of its equipment abroad, thereby incurring high transportation, assembly and customs charges; machine operating time is insufficient; control of production costs is inadequate; and quality control is poor.

Because of the complete absence of locally produced machinery in many cases, and the excessively high prices demanded for it when it is available, it is unlikely that improvements can be expected in this area for some years to come. To a large extent, however, productivity depends on the determination of the head of an enterprise, the quality of the management and the general organization of the plant.

Modernization of equipment is no panacea for poor operating efficiency. It is only another measure, albeit an important one, which, if it is to be fully effective in obtaining the maximum return from the investment, must be accompanied by proper organization and planning.

For the purposes of this article, modernization, when applied to management and supervisory systems, shall be referred to as the productivity of a plant.

A study recently carried out by a UNIDO textile adviser assigned to the Ministry of Industry and Commerce in Brazil showed that without determination on the part of the head of an enterprise, the implementation of systems of checking, and refined operational methods, a machine cannot produce what it was designed to produce, and a worker cannot operate at full efficiency.

Plant design

Good design is essential if a plant is to operate efficiently. Many enterprises, which do not have the expertise necessary to plan a new plant properly, often assume that they will save money by setting up plants themselves without seeking expert help. Such plants are invariably poorly planned and have to be remodelled before they can function economically. If the expertise necessary to design a new plant is available within the existing structure of the enterprise so much the better, but to attempt such design work without specialist help, from whatever source, is false economy. This is one of the reasons for low efficiency and high prices in the Latin American textile industry.

Apart from the preliminary market survey, which is the basis for any industrial installation, the following essential points should be considered in the technical study which precedes actual construction work:

> The most economical size of plant that will accommodate a production plan providing as near perfect balance as possible between the various manufacturing processes, the optimum use of labour, and the highest and best productivity levels.
>
> The selection of machinery and auxiliary equipment whose performance is guaranteed by the manufacturers, taking into account its price and the level and quality of production it offers. It goes without saying that cheap machinery which suffers from frequent mechanical breakdowns can cause serious operating losses. It should be added that the installation of an air-conditioning system suited to prevailing climatic conditions will make an obvious contribution towards increasing the level and quality of production.
>
> Plant layout which permits the maximum utilization of staff and reduces waiting time and unnecessary handling is desirable and will accelerate production rates. This design should also be flexible enough to allow future expansion to take place without interrupting production.

Raw materials

A plan for the selection of raw materials should be drawn up prior to plant installation to ensure their availability in sufficient quantities and to assess their quality and suitability. The organization of the plant should be such that the best possible use is made of the raw materials. Certain measures may be taken in this respect:

- Strict supervision of waste at each stage in the production process (opening and picking, carding, drawing out, combing (if any), etc.) must be carried out.

- Quality must be systematically controlled at each stage in the production of both intermediate and finished products. This should result in the achievement of the best possible end product quality with an increased market value, and a substantial increase in production. The good quality of each intermediate product facilitates the efficient working of the machine, reduces stoppages and breakages and results in increased actual machine operating time. In order to carry out this quality control, the following are required: *(a)* a laboratory equipped with instruments to effect intermediate controls with the minimum of delays so that results can be rapidly transmitted to the respective production departments, and *(b)* finished fabric inspection machines to produce immediate reports on any defects observed and transmit the findings to the responsible machine operator for immediate action.

- These installations obviously entail supplementary investments and operating expenses. However, they are to a very large degree amortized and rapidly offset by the increased value of the end product and the increased production levels described above.

- Stocks of raw materials, intermediate and finished products, should be supervised in order to avoid interruptions in supply, which would paralyse production, or excessive stocking, which would tie up too much capital.

Equipment

The cost of modern machinery is now so high that it is essential to make maximum use of it in order to reduce as much as possible the effect of its amortization on the cost price of the product. One of the reasons why textiles from the Far East are sold at very low prices is that textile machinery in this area is kept in operation as much as 8,640 hours a year, which reduces the implications of fixed charges to a minimum.

Continuous working, seven days a week, is not a general practice in Latin America. The normal day shift is 7½ hours, night shifts work a half hour less. Many hours of useful work are thus lost. It is not uncommon for plants to operate a two-shift system, but even those operating three shifts often work only 6,000 hours a year. Other plants have arranged their shifts in such a way that they can operate up to 7,200 hours a year. Nevertheless, even taking into account vacations of twenty working days and other holidays, 8,200 operating hours a year should be possible and is desirable. Plants equipped with modern machinery should, therefore, endeavour to arrange their schedules so that their equipment is used either continuously or as near to it as possible.

To work towards this goal, it is necessary to provide the following in-plant organization:

- Machine stoppages, both routine (feeding in, or removing, the machine inputs or outputs), and occasional (mechanical breakdown, breakage of materials, interruption of input supplies and operative absenteeism), must be strictly controlled. In the former case, supervision makes it possible to ensure that loading and unloading operations do not exceed the standards fixed for obtaining the best possible output; the latter type should be totally eliminated.

- Preventive maintenance, in accordance with the machine manufacturer's instructions, should be carried out regularly.

- Stocks of spare parts kept in stores should be carefully registered. Each part should have a minimum and maximum level for re-stocking clearly indicated, which must be closely supervised to avoid the tying up of excessive capital.

- Stocks of raw materials should be controlled to prevent stoppages caused by lack of inputs to the machines.

- Quality should be controlled in order to minimize stoppages caused by breakages.

Manpower

The personnel employed in the plant must function as efficiently as possible. To this end, it is essential that an organizational diagram be drawn up for the total labour force. Manuals describing the functions of each individual in as much detail as possible and precisely defining his responsibilities should be prepared. The organization should not be static, but should change in response to increased productivity, the results of studies on methods and the development of the plant.

This makes it necessary to establish in every plant, whether it be a spinnery or a vertically integrated operation, a permanent vocational training department closely linked to a methods study service.

The vocational training department is responsible for training workers by uniform methods. It is very important to standardize working methods and ensure that everyone who does the same job does it in the same way. The economic efficiency of the plant will thus be enhanced and pay calculations simplified as workers with the same duties, expending the same amount of effort, will be paid the same wages. One of the objectives of uniform vocational training is therefore to achieve a fair rate for the job.

In many cases, management considers that the recruitment of workers trained by vocational schools is sufficient to ensure good productivity and neglect to follow up with in-plant training.

Without this additional training however they will be unable to achieve the team spirit and uniformity of work that are prerequisites of high productivity. They will also be unable to improve production or to re-train workers displaced by automation.

The vocational training department should be supplemented by a study service which would keep a constant watch on and seek means of reducing the time and movement involved in work. It would also keep a check on machine stoppages and transmit the findings of these checks, with suggestions for improving the methods used, to management. The vocational training department must take into account suggestions for improvement, once they have been approved by the department heads, making the appropriate changes in its training manuals and retraining workers as quickly as possible.

The activities of the permanent vocational training department should be directed not only towards shop floor workers, but towards their immediate supervisors.

This department should also assist the department heads and engineers at the plant to keep abreast of current technological developments by providing them with up-to-date documentation and international technical reviews in their field. It can also help by organizing seminars for the staff or arranging for their participation in other seminars, and by arranging for them to travel abroad to see international textile machinery exhibitions.

General organization of the plant

The controls and studies described above have no value if information at all levels of the company structure is not properly communicated. Likewise, a high level of productivity will not ensure the prosperity of an enterprise if its commercial organization is inadequate.

The supplementary aspects of the measures recommended above relate, therefore, to the general structure of the enterprise and can be summarized under three main headings:

Communication of information. This requires perfect planning, screening and summarizing of information and data for ultimate communication to the head of the enterprise in the form of a "log book" containing all the intelligence he needs to lay down general managerial guidelines and for making decisions.

Control of production costs. This is usually the weak point in even the best organized of enterprises. A check makes it possible to determine the profitability of each of the items produced and, consequently, to draw up production programmes concentrating on the most profitable. It also makes it possible to ascertain, and correct, weak points in an operational process. Finally, it constitutes the basis for determining a fair sales price for the products.

Control can be established by various means, the main ones being industrial or analytical bookkeeping, and budgetary control.

Budgetary control makes it possible to carry out a simple, detailed analysis of the factors affecting the cost of the product at each processing stage and provides information quickly and frequently, even weekly, if desired.

By studying the profit or loss shown by the comparison of real expenditure with the standards established following an investigation into specific plant conditions and equipment, it is possible to follow the development of the enterprise on a continuing basis and to determine the rate of profitability that may be expected of it. In the final analysis, this is a permanent working account, the results of which appear regularly on the chief executive's desk.

Commercial organization. This should complement its industrial counterpart. It involves frequent and regular contacts between the sales and production services and periodic analyses (at least once a month) of stocks of finished products and materials entering the manufacturing process in order to ensure the most complete co-ordination possible.

Commercial services should know the results of the production price controls in order to be able to promote sales of the most profitable items.

In Latin America, it is very often found that the distribution systems for traditional industrial products (primarily textiles) are outdated and no longer suited to modern production requirements.

Conclusions

The foregoing description of the conditions necessary for an improvement in the Latin American textile industry is far from exhaustive, but it shows that if the heads of enterprises are determined to act on certain basic principles, it is possible to transform the industry to a dynamic one that can contribute substantially to the economic development of the region.

It is unfortunate that the textile industry is generally looked upon as "traditional" and its development neglected in favour of the so-called "vanguard" industries.

Modernization of this industry, with regard to both management and equipment, will help it to play an active role in international trade and to improve the standard of living locally. Governments should consider this industry when formulating their industrial policies and assist in its improvement by including in their programmes for industrial development facilities for all industrialists who wish to convert their plants into dynamic and efficient undertakings.

Numerical Control for Developing Countries

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Like any new and revolutionary manufacturing concept, numerical control (NC) intrigues many people in the industries to which it might be applied, but because of this newness, misunderstandings and misconceptions exist concerning its potential for any company, industry, country or region. Some believe it to be the final answer to every machinery need and the key to instant industrialization; others think it over-rated. NC is none of these, however. it is not a cure-all but neither is it over-rated. It is potentially applicable to the vast majority of metalworking operations, in both developed and developing countries. However, it need not, should not, and cannot, replace conventional machine tools in every operation.

The use of NC, which is often referred to as the "second industrial revolution", is expanding continually throughout the world. Though NC had its first practical application in the metalworking industry over 15 years ago, methods and machinery are still very much in flux. No single set of standards has yet been established, nor is it likely that much standardization will take place in the near future, mainly because of the inherent flexibility of the system. The work to be done in individual plants determines the form taken by NC regardless of other factors.

By definition, numerical control is a technique for controlling machine tools (or other processes) through commands given in symbolic form on a punched tape.

The usual way to set up an NC operation is to study an engineering drawing (or other mathematically precise specification) and determine what actions and reactions the machine tool will have to make to produce the desired configuration. The person who makes this analysis and works out the commands to the machine tool is commonly called the "part programmer". His commands are punched into a tape in a code which the machine control unit (MCU) can understand.

The punched tape is then taken to the machine and loaded onto the MCU. At the command of the machine tool operator, the MCU reads the code and causes the machine tool to follow the instructions as they appear on the tape, just as if a human operator were controlling it.

Since the same tape may be run over and over again, the machine can make any number of identical pieces from the one code. Thus, though there are some exceptions, NC is mainly a tool for volume production.

However, volume production does not necessarily mean mass, or large batch, production. NC, by itself, is not likely to replace transfer lines, automatic machine tools, or other automated methods that are economically used today to produce large batches. It is essentially of value in small batch production, and that is what makes the concept particularly attractive to developing countries where the ability to produce one, two, three, . . . 20, 30 or even 1,000 identical pieces in a batch is enormously significant and useful. With a simple group of pre-programmed tapes and by controlling the sequence and number of times each is read, it is easy to produce, say, six items of one configuration, ten of another, and 100 of yet another. This is true flexibility in the scheduling and loading of machine tools.

When this possibility of flexibility in batch size and configuration is considered against the fact that 80 per cent of the world's metalworking production consists of batch sizes of 50 or less, the true potential of numerical control can be readily understood.

A further advantage of NC is that it is easily adapted to engineering changes. As most such changes affect only a portion of a metal part, they require changes in only a portion of a tape.

These three advantages (flexibility, small batch production and acceptance of engineering changes) should be appreciated by everyone in the metalworking industry.

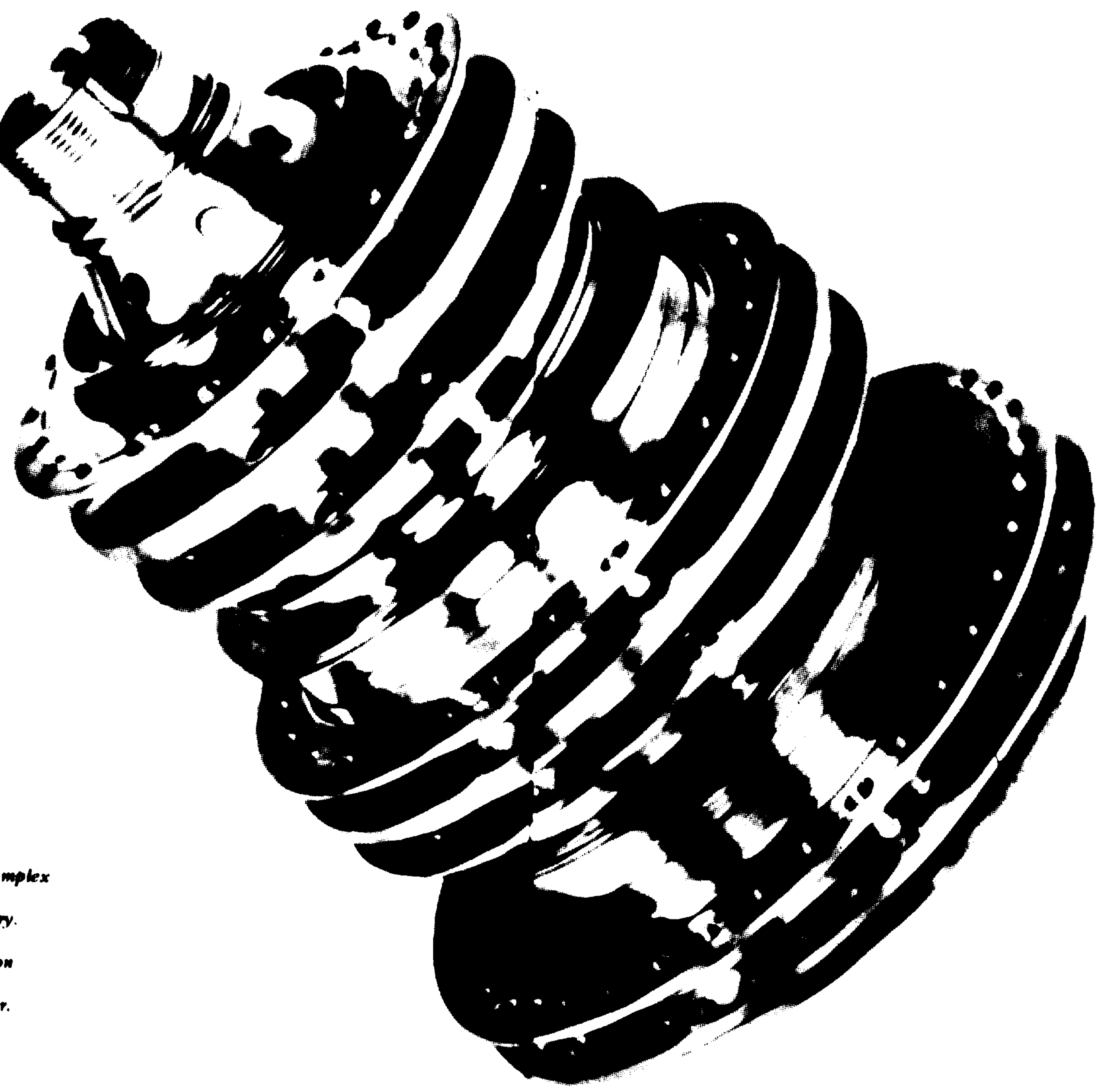
Numerical control is not some futuristic theory. it is already a practical reality in thousands of plants. Its implications and ramifications are such that developing countries now building metalworking industries must seriously consider it in their plans. Indeed, any industry or country that now invests in only conventional, standard machine tools will find itself at least 15 years behind the times on the very day it goes into production.

This is just as true for the developing countries as for the developed. Yet there is a common belief that NC is too advanced and too complicated for introduction to developing countries at this time. However, waiting for the local metalworking industry to catch up with NC may well lead to the forced replacement of relatively new equipment. Not enough thought has been given to what a planned training programme could do to remove these complications. There is no reason why a developing country should start out with a metalworking industry 50 or 100 years out of date; on the other hand, a developing country cannot be expected to work immediately with the most advanced and complex NC units on short notice without encountering problems. In simple terms, no one can properly use what he does not understand.

Every country, developed or developing, should find its own starting point for the introduction of a numerical control programme that is both comfortable and acceptable. Thus, no two companies, industries, countries or regions need necessarily begin in the same manner or at the same level.

There is no definite set of prerequisites for the successful introduction of NC, nor is there a magic formula that can infallibly determine its potential. There are, however, simple questions that can be asked in order to determine whether there is a potential for NC:

- Does the country now have a metalworking industry?
- Is this industry dependent upon machine tools which produce chips, as opposed to stamping, rough forms etc.?



High-precision complex item for rotating machinery. NC makes even one-off production of such items easier and cheaper.

By J. Moorhead

The author:
Mr. Moorhead is General Manager of J. A. Moorhead Associates.

Does the machining consist to some extent of drilling, milling, turning, boring, punching, flame cutting etc.?

Is some portion of the production on these machine tools in small batches (i.e. 100 or less)?

Are engineering changes now common or will there be an increasing number of them in the future?

If the answer was "yes" to each of the above, there is a good potential for NC.

Remaining steps to establish the parameters for an NC machine tool industry would entail the collection of such data as machine tool inventories, current production batch sizes, product diversity within given installations etc. Each of these inputs would be either "pro" or "con". Up to this stage, however, only generalities have been discussed, it is now necessary to determine specifics such as personnel, markets, raw material supply, maintenance and repair, and power supply. When these have been determined, it becomes considerably easier to find the best way to begin an NC programme.

There is not much in the field of numerical control that cannot be taught. Though the state of the art does extend to advanced computer installations, metrological equipment, electronics etc., it does not have to begin at the level. The introduction of numerical control into an industry is more closely tied to the ability and willingness of those in the industry to learn than it is to their ability to work metals with machine tools.

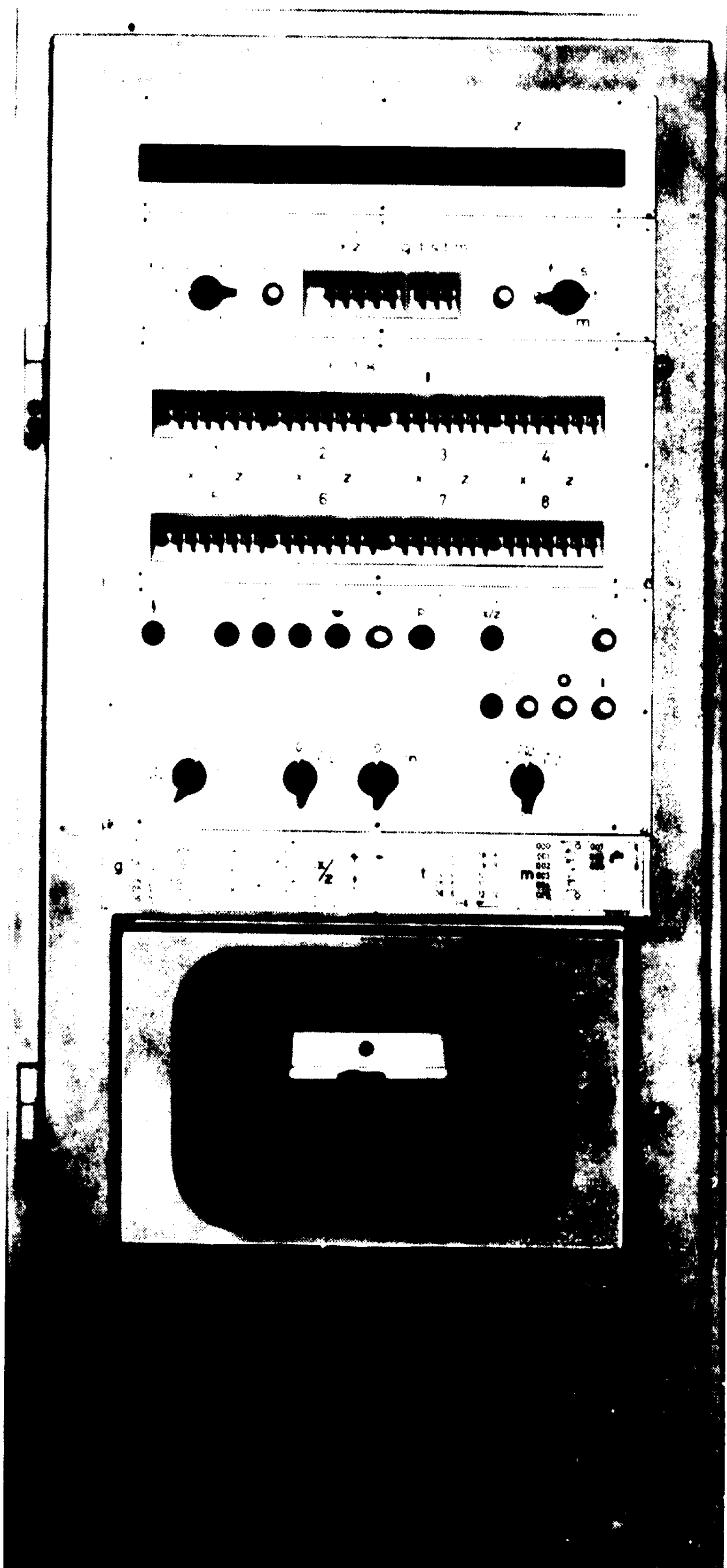
A developing country with absolutely no metal working skills or knowledge will find it hard to introduce numerical control. It is possible, but the teaching programmes have to be expanded to include basic training.

However, people with no metalworking background or experience are economically and successfully producing acceptable parts on numerically controlled machine tools. This is most often accomplished by recognizing the operators' capabilities and adjusting the system to allow them to become productive immediately. Their skills can be upgraded later.

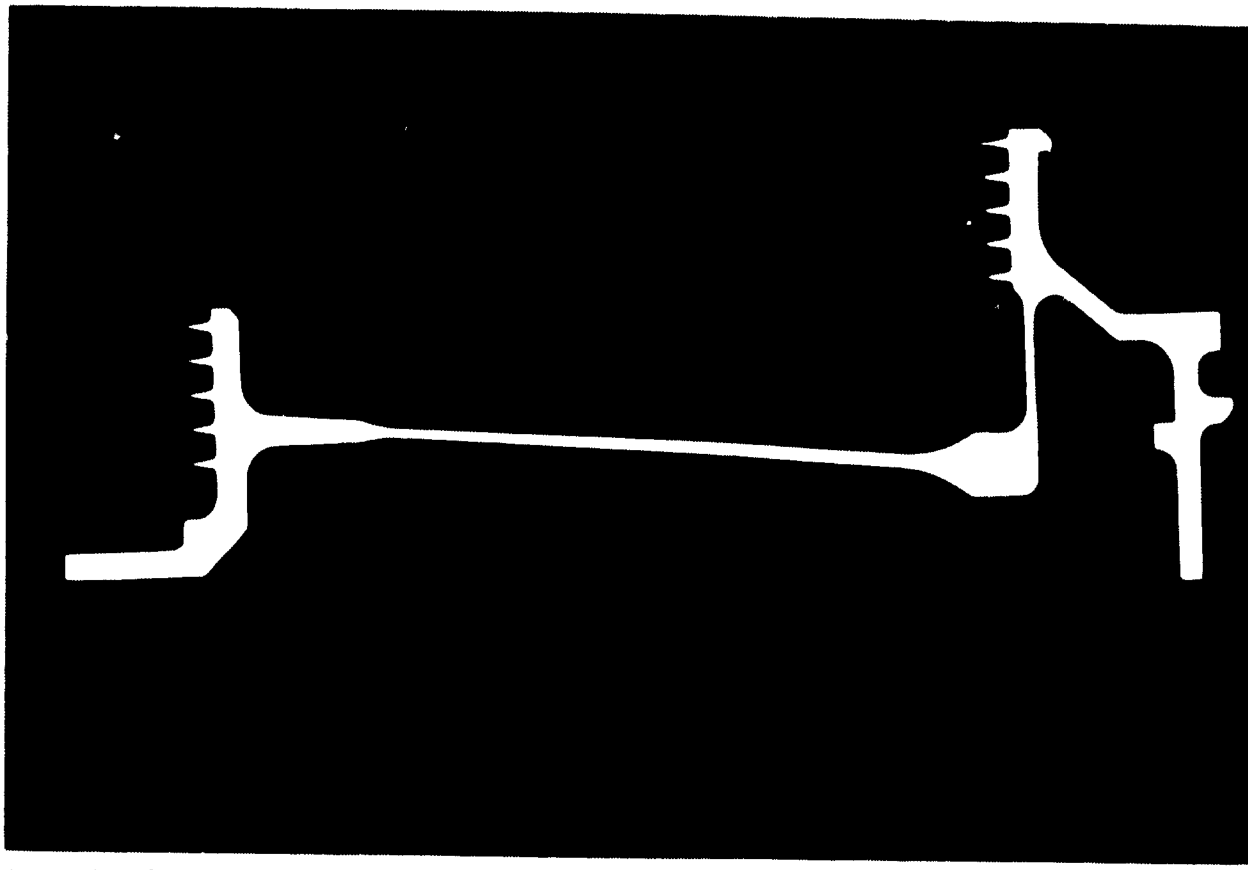
This type of adjustment suiting the system to the workers is not restricted to the developing countries. Many developed countries are being forced to make the same compromise to compensate for the shortage of skilled labour caused by the reluctance of young people to enter the metalworking industry as apprentices.

Developing countries that possess conventional machine tools already have the manpower base for NC. This is true even if the existing plant is not being used efficiently. Some of the better educated personnel can be trained as part programmers and to prepare tapes for NC machines.

In this article so far NC has been treated as a manufacturing concept, not just another machine tool.



Face of an NC control unit. Note the program tape loop visible in window. This is the heart of the system. All the knobs and buttons are for tool changes and for making minor adjustments.



Cross-section of complex metal part that NC lathe can make routinely and identically in small or large batches.

Sometimes the fear is expressed that its ramifications will upset and dislocate the various groups that make up an engineering or manufacturing organization. NC can indeed affect the functions of the design engineering, tool design, production, scheduling and inspection departments. In fact, the only departments of a plant not affected by a total NC installation are the food service, medical services and plant security.

However, the installation of an NC system does not have to result in major changes and the re-shuffling of large groups of people. Ideally, management will introduce the concept smoothly and integrate it into the plant with a minimum of delay or difficulty. How and when to make additional changes will be a matter of individual choice, based on experience and needs. Any hidden factors or pitfalls that show up can usually be traced directly to the person or persons who investigated, evaluated, selected, economically justified and bought the equipment.

Numerical control can be introduced one step at a time. A general understanding of the concept in relation to a particular situation can be acquired in a two-day familiarization course. If this indicates that NC has potential, it can be followed up by five days of more intensive familiarization work. If it still appears likely to be successful, it takes only two more weeks to learn to investigate, evaluate, select, organize and implement a system. Naturally, the various operating personnel within the plant will need considerable training, but this can be detailed beforehand. Allowing a six- to eight-hour training period per day, a team of two or three persons can go from point zero to mastery of a complete NC installation in less than eight months, even taking into account the considerable time needed to review each decision and to collect data and information.

Training can help to avoid the type of mistakes made in the past by those who first entered the NC field. The most common error was the selection, by companies, of a relatively simple NC machine "to learn on". One of the first things they learned was that the machine they had selected was the wrong one for the work they wished to do.

Training for numerical control has advanced to the point where potential users can be helped to select the right personnel for each of the various tasks to be performed. Thus, the user can employ his trained personnel with greater efficiency. Special correspondence or home study courses, pre-testing programmes, audio-visual techniques, and combined classroom-consulting programmes have all been developed for NC training. These flexible training methods make it simple for anyone interested in the metalworking industry to investigate the potential of numerical control.

A tape-controlled NC lathe at work. Note three finished pieces to left on floor, another on machine. NC unit, with tape visible in window, is next to lathe on right. Tape program automatically changes tools, moves work piece while operator stands by.

NC has proven itself to be an economical proposition. In the developed countries there are now such NC derivatives as computer-aided design (CAD), computer-aided manufacturing (CAM), and direct numerical control (DNC).

Any country with a number of general purpose machine tools should investigate NC. A system is available which allows a country to carry out an NC investigation with only two men. These representatives make a fair and impartial study of the potential of NC and, at the same time, acquire a basic training which helps them, in turn, to become trainers, should NC prove to be economically justifiable. They can then help management and operating personnel to make the transition to NC smoothly and easily.

This two-man team will be able to adapt the training to the local educational system and industry so that as NC grows the country will have the trained manpower needed for the expansion. The team will also be responsible for maintaining a central NC information centre. This is important as some of the greatest problems in numerical control have been created by short-range decisions based on inadequate information. A proper and early understanding of the potential of NC can help avoid these problems.

This team-training system is based largely on correspondence. Naturally, the team members must see NC equipment in action, but a little preparation makes the viewing that much more effective. No developing country should feel obliged to take a path identical to that of any other country; the system must therefore be designed to meet the conditions existing within the local metalworking industry and the goals that have been established for its development. The system should fit the country; the country should not fit the system.

The questions that now arise are: Where is the starting-place? When buying NC machine tools is it wise to select a particular type of machine and then attempt to justify it economically and understand it? Or is it better to study NC and try to apply it to a particular type of machine?

In reality, neither method is the most efficient. The most practical, workable and least time-consuming approach is to gain an understanding of the over-all NC concept and to apply its principles to a particular type

NC lathes at work showing yet another design and make of control unit.

of machine tool. This machine may not prove to be economically justifiable, but it will provide the practical knowledge necessary to make satisfactory evaluations in the future. Some study of the theory of NC is also required.

As mentioned before, an entire programme can be completed in about eight calendar months. Some have been completed in less than four, however. It need not necessarily be a full-time job for the team setting it up but can be scheduled according to the time they have available. Naturally, if they must approach the plan on a part-time basis, it will take longer.

The way to get from the present state of the art to NC is through training: training that has been proven and applied to a wide range of situations, training that corresponds to the current situation within each country; training that is structured to help the team members set up a continuous training system for a particular industry and educational system; training that teaches a variety of possible applications.

The potential of numerical control is enormous. It may not be the answer to every problem in every plant in every industry in every country, but its capability should at least be investigated. As its potential for the future is becoming ever more obvious, no industry or country can afford to neglect it.

New Products Processes

Readers requiring more information about products or services mentioned in this column should write direct to the individuals or companies concerned.

WATER-FILLED BALLOON STEMS THE TIDE

The first hydro-[illegible] has been installed in the Netherlands. The unit, reportedly simple and relatively inexpensive to install and maintain, consists of a water-filled cylindrical rubber tube with conical ends. A concrete sill weights the centre portion, holding it fast to the river bed.

Rubberfabriek Vredestein, Loosduinen, N.V., Netherlands

LOW-COST HOUSING

One promising innovation for use in the construction of houses of concrete blocks eliminates the use of mortar between the blocks. Blocks are stacked dry and a bonding mix is trowelled on both surfaces of the wall. The mix is essentially a cement grout reinforced by 1/2-inch lengths of chopped fibre glass filaments. An unskilled person can soon learn to use the mix, which can be applied almost as fast as paint. The strength of the surface bond is three or more times greater than regular between-the-blocks mortar, even though only thin coats about a sixteenth of an inch thick are used.

J. W. Simons and B. C. Haynes, Jr., Agricultural Research Service, USDA Agricultural Engineering Center University of Georgia, Athens, Georgia 30601, United States of America

LATERITE BRICKS

Two Danish research workers are making building bricks out of laterite, the red soil that covers large parts of tropical and subtropical Africa, south Asia, South America and Australia. They have found a method of stabilizing it to produce a low cost building material similar in quality to baked bricks or concrete. The bricks are cast in a primitive press and sun-baked at temperatures of about 104–122 degrees Fahrenheit.

Torben Hansen, Building Materials Laboratory, Technical University of Denmark, Building 118, Lundtoftevej 100, Copenhagen, Denmark

MARINE MUD FOR CONSTRUCTION

It is reported that marine mud from coastal areas with nearby Pleistocene deposits contains sediments that can be used in the building industry. The ceramic material produced by dehydrating, shaping and firing this mud can be turned into aggregate for concrete structures, bricks with an unusually high strength-weight ratio or a powder useful as a starting material in the manufacture of Portland cement.

Donald C. Rhoads, Yale University, New Haven, Conn 06520, United States of America

STABILIZING DESERT SAND

A new defence against erosion caused by advancing sand dunes is a synthetic resin emulsion that can be sprayed over large areas to consolidate the top soil. The resin also seals in moisture so that grass or other seeds mixed with it will sprout in a short time to give long-term sand consolidation.

Hoechst UK Ltd., Hoechst House, Salisbury Road, Hounslow, Middlesex, England

Synthetic rubber has also been used to bind the drifting blowing sands of the Libyan desert. Tested on 400 acres of desert planted with 60 000 eucalyptus trees, this process has been 90 per cent successful.

International Synthetic Rubber Company, Brunswick House, Brunswick Place, Southampton SO9 3AT, England

Again, in the Libyan Arab Republic, heavy oil sprayed on the surface of sand dunes has, in ten years, stabilized the dunes and enabled them to yield valuable eucalyptus forests. The oil permits rain to enter the ground freely but retards its evaporation. In addition, the resultant blackened surface of the treated area absorbs more of the winter sun's warmth than untreated sand, and helps promote new growth.

Forestry Department, Ministry of Agriculture, Tripoli, Libyan Arab Republic

SYNTHETIC DIAMONDS CUT LOSSES

Two new cutting-tool inserts designed to cut through the world's toughest metals, alloys and composite materials at high speeds but with little wear have been developed by scientists at the General Electric Research and Development Center in the United States of America.

Made from tiny crystals of synthetic diamond or cubic boron nitride, the hardest materials known to man, the inserts promise to provide the metalworking and material removal industries with dramatic gains in productivity.

After years of research, General Electric scientists have learned how to process these crystals into a practically indestructible polycrystalline "compact" backed by a cemented carbide base. This represents a major breakthrough in high-pressure, high-temperature technology, a field in which the scientists have pioneered for more than two decades. In 1955, General Electric announced the first reproducible process for synthetic diamonds, and the company began making and selling diamond abrasives two years later.

The synthesis of industrial diamond abrasives requires the simultaneous application of nearly 1 million pounds of pressure per square inch and temperatures above 2,200° F. To create a single diamond "compact" cutting tool, a similar process had to be developed.

After the compacts have been formed, they are processed into triangular, round, or square shaped indexable inserts. Compact tools in sizes ranging from one quarter to five-eighths of an inch have been produced in this way.

Although the new inserts are not commercially available yet, and no price has been established, sample quantities are being manufactured for use in extensive field testing operations. These tests have demonstrated that the new tools have cutting speeds up to eight times faster than those of conventional, carbide metalworking tools when used on alloys that are normally difficult to machine. In machining certain abrasive composite materials they last at least a thousand times longer than carbide tools.

General Electric Research and Development Center, United States of America

Flames from a blow-torch have no effect on this new cutting tool insert developed by scientists at the General Electric Research and Development Center. Fabricated from thousands of tiny crystals of cubic boron nitride, a material second in hardness only to diamond, it can machine superhard metals eight times faster than conventional cutting tools.

BOILING NITROGEN KEEPS IT COOL

A complete refrigeration system consisting of an insulated tank and an inlet pipe for filling it with liquid nitrogen has been developed by British Oxygen. The low temperature is maintained by boiling liquid nitrogen. Empty, the equipment weighs only 20 lbs. It holds 80 lbs. of liquid nitrogen. Apart from the daily refill there is no maintenance required.

British Oxygen Company, Hammersmith House, Hammersmith, London, W.6., England

Industrial Inquiry Service

The UNIDO Industrial Inquiry Service receives requests from developing countries for possible solutions to a wide variety of industrial problems. To give readers an idea of the range of the topics covered, each issue of the Industrial Research and Development News *carries a selected list of questions recently received by the Service in addition to an answer to a specific inquiry.*

Readers are invited to write to the Industrial Inquiry Service for further information on answers to any of the questions published below, or to submit inquiries on similar or other industrial problems.

An inquirer in Peru requested information on the industrial manufacture of plaster from limestone (X 2786 87). The following is a condensed version of the reply received from a consultant in Israel.

Plaster

Plaster, a material for finishing interior and exterior walls, is made of mortar consisting of a binder and fine aggregates. The usual composition is lime, sand and Portland cement, in different proportions, depending on the strength, water absorption, permeability and rain resistance required. Synthetic resins are also being used as binders instead of lime and cement.

Limestone as such is not a plastering material and plaster cannot be made from it alone. Limestone serves as a raw material for the production of concrete aggregates and burned lime. In the chemical industry, lime is used extensively as a neutralizing agent for acid residues or wastes, as it is one of the cheapest alkalis available.

Lime is used in the building industry for the manufacture of bricks, blocks and mortars. Sand-lime, bricks and blocks are produced from lime and almost pure silica sand. Light building stones, blocks, panels and other building elements are produced from "Ytong", a product made from lime mixed with ground silica sand to which water and small quantities of aluminium powder and sugar solution are added. The mixture is cast in steel moulds and cured under steam pressure at 10 12 atm. A number of other products, known as artificial stones, are produced in small quantities from lime combined with binders and additives. Lime is widely used in the lime-soda process for water softening.

Lime burning

Limestone is widely available, sometimes as pure $CaCO_3$, in the form of marble, and sometimes as chalk, but mainly as common rock containing small quantities of silica, alumina and iron oxides. By calcining limestone containing over 97 per cent calcium carbonate, high calcium or chemical lime is produced. If the rock contains $MgCO_3$, lime containing magnesia, or dolomitic lime, is obtained on burning. If the content of silica and alumina in limestone exceeds 8 per cent, hydraulic limes result. Depending on the quantities of these oxides and the calcining temperature, "weak" or "strong" hydraulic lime is produced.

Two main types of kiln construction are used for lime burning: shaft and rotary.

Fuels used in lime burning. Most fuels can be used: coal, coke, wood, oil and gas. The type of kiln selected depends generally on the production capacity desired and the kind of fuel available determines its precise design. For production capacities of less than 30,000 tons/year, shaft kilns are used. For capacities of between 30,000 and 100,000 tons/year, shaft or rotary kilns are installed. For higher capacities, rotary kilns are used almost exclusively.

Generally speaking, for an equal production capacity, a rotary kiln requires more fuel but less work per ton produced than a shaft kiln. Rotary kilns are highly instrumented and automated; shaft kilns require more skilled work. Investments in rotary kilns, at equal production capacity, are higher. The highest production capacity so far achieved for a shaft kiln was 150 tons/24 hours but there are rotary kilns producing 1,500 tons/24 hours.

The smallest lime kiln, the so-called intermittent field kiln, is fired with boscage, wood or oil. Such a kiln normally produces 30–50 tons of lime per charge, involving not less than 6 days of work for 3–4 workers: two days for charging and building the kiln; 3–5 days, around-the-clock, for burning the charge; and one day for cooling and discharging the lime. The fuel quantity required for burning one ton of lime is about 2 million Kcal.

Another good, small lime kiln, the Ellermann, is fired with oil and produces 12–16 tons/day using 160–165 kg of oil per ton of lime.

Shaft kilns capable of producing around 50 tons/day are numerous and come in a variety of designs, according to the type of fuel used.

The mixed-fired kiln uses coke or other solid fuels. This kiln can be operated with forced or induced draught. Sometimes the coal available is easier to use in gasified form. In this case a special apparatus to produce gas from coal is erected and the lime kiln operated as a gas-fired shaft kiln. Where cheap natural gas is available, a direct gasified kiln is the best solution.

There are many types of gas- or oil-fired shaft kilns. The main shaft, which is normally 30–40 feet high, is either a round or a square-shaped pipe with a free internal diameter of from 4 to 10 feet. The interior of the shaft is lined with refractory bricks the quality of which is very important to the efficiency and economic aspects of the lime burning.

The rotary kiln is a slightly inclined tube, varying in diameter and length, according to production capacity, which rotates around its main axis. The approximative volume of this kiln is 40–50 times its daily production capacity. Additional equipment, such as head exchangers and pre-heaters, may be added if it is desired to reduce its physical length. The stone is fed in from the top and the burned lime is discharged from the bottom.

Essential kiln components

To achieve economies of fuel, the kiln is divided into three areas or zones called, respectively, the pre-heating, calcining and cooling zones. If the pre-heating zone is short, the exit gases are hot, resulting in loss of heat. If this zone is very long, there may be radiation losses and higher construction and operating costs. The length of the calcining zone increases with the stone size. "Cubic" stones are desirable.

Field kiln. A rectangular, or preferably round, shaft, approximately 13 feet in diameter, is sunk in the side of a hill. This hollow shaft is filled with limestone pieces in such a manner that a free cavity is left in the middle in the shape of a Mauretanish roof. Care should be taken to make sure that the construction is safe. Large stones, more than one cubic foot, are placed in the centre and smaller stones on the periphery and on top. A communication channel of about 20 inches, leading from the central hollow part of the heap to the exterior, is left. This channel serves for the introduction of the fuel.

Shaft kilns. The shaft is shaped according to the fuel used. Normal production capacity of a shaft kiln is between 50 and 100 tons/day, independent of the fuel used. Limestone lumps of a predetermined size are introduced from the top of the shaft and the burned lime is discharged from the base. In order to produce good quality lime, lumps of uniform size are used, e.g. smaller than 6 cubic inches, or smaller than 4 and bigger than 2. For even smaller sizes, specially constructed shaft kilns are used. The charge in the kiln must leave free passage for the incoming combustion air and the outgoing burned gases.

Rotary kilns. As already mentioned, a rotary kiln is a steel tube, slightly inclined, rotating around its central axis. The pre-heating zone is sometimes an integral part of the tube, forming a long rotary kiln; sometimes it is a separate shaft or hot cyclone of different construction with a shorter rotating tube. The cooling element may be a separate rotating tube arranged under the main rotating kiln tube, a few smaller tubes fixed around the main rotating tube, or a grate under the kiln. Crushed limestone pieces, generally smaller than ½ cubic inch, but free of dust, are fed in from the high side of the kiln or pre-heater. The outgoing burned gases are used to pre-heat the limestone. After the lime is burned, it leaves the kiln and passes to the cooler. The combustion air passes around the lime which is cooled and the air is pre heated. In this way better fuel economy is achieved.

Theoretically, only 850 Kcal fuel are required to burn 1 kg of lime (for the production of 1 ton of lime, 1,800 kg of limestone are necessary), but in practice, in the best constructed shaft kilns, 950 1,000 Kcal are necessary, in a good rotary kiln, 1,500 1,700 are used.

In order to produced the 1,8 tons of kiln feed stones of suitable size necessary for the production of 1 ton of lime, 2,4 to 3 tons of stone must be quarried.

Production flow

From the limestone quarry the limestone is brought to the crushing and sizing plant. The stones pass through the crusher to the sizing screen. Coarse lumps are returned to the crusher; finer pieces are dumped, to be used later, depending on the size, as concrete aggregates, road surfacing material or filling material for roads or foundations. Material of the right size is stored in silos as kiln fee. In many cases the stones are screened again before being charged to the kiln in order to separate dust or smaller pieces produced during transport and handling.

The limestone is fed into the rotary kiln from one side, the fuel and air enter from the opposite side. Solid fuel in shaft kilns is mixed with the limestone lumps. The burned lime is stored in closed silos while awaiting dispatch or use. This lime must be slaked before use. Slaking, which may be either "dry" or "wet", is essentially the following process:

CaO + water ——→ $Ca(OH)_2$ (dry slaked lime)
(lime) ——→ lime putty (wet slaked lime)

The quantity of water added to obtain a workable putty depends on the characteristics of the lime, i.e. burning temperature and limestone purity. Dry slaking is carried out in special machines. The material thus obtained, "hydrated lime", is a fine, soft, light powder.

To produce building mortar or plaster from hydrated lime, the powder is mixed, usually the night before, with water.

The lime slaking is accompanied by heat development to produce an exothermic reaction. Care must be taken to see that the quantity of water is accurately measured if it is to produce the desired quality of lime. Lime slakers say that lime putty can be either "drowned" or "burned" during slaking. If the water component is too high, the resultant lime putty will not have sufficient plasticity and if it is too low, the putty will contain agglomerated grains and popping and pitting will occur on the finished plaster. One part lime putty to 3 4 parts sand are used to make mortar for inside plastering. For outside plastering, Portland cement is added to the mortar, the measures being usually 1 part cement 3 5 parts lime putty and 12 18 parts sand.

Sandlime bricks silica bricks. Silica sand having at least 90 per cent SiO_2 and not more than 4 per cent clay is mixed with dry slaked or ground burned lime and water (the quantity depending on the fineness of the sand and quality of the lime) and moulded into bricks. The pressed bricks are stapled on racks, introduced in autoclaves, and treated under steam pressure of 7 14 atm. The pressure and curing time in the autoclave have a marked influence on the strength of the bricks produced. Higher pressure and/or longer curing in the autoclave increase the strength of the product.

"*Ytong*" is produced from silica sand having at least 95 per cent SiO_2 finely ground, mixed with dry slaked or ground lime and water to a putty to which aluminium powder and small quantities of sugar (to regulate the binding properties of the mixture) are added. The putty is poured into steel moulds and left to expand as a result of the evolving hydrogen. The mixture is left for approximately one hour before being placed in the autoclave for hardening, in a fashion similar to silica bricks. Other products similar to "Ytong" are "Microporit" and "Turite". For these products the proportioning of the mixtures depends on the quality and grain size of the sand and on the quality of the lime.

MACHINE TOOL SEMINAR – *See article following page*

From left to right: Mr. Berger, rapporteur; Mr. Krainov, director; Mr. Bangora, Chairman; Mr. Henning, General co-ordinator; and Mr. Aselmann, Industrial Development Field Adviser for the Andean Group Countries.

Mr. E. Parellada, Ministry of Industry and Mining, Argentina, addresses the Seminar.

PROJECTS

Regional seminar on machine tools for countries in Latin America

At the Interregional Symposium on the Development of Metalworking Industries in Developing Countries held at Moscow in 1966 it was recommended that seminars be held in various regions in order to discuss the specific problems encountered by these regions in developing their metalworking industries. Special attention was to be given to the machine tool section, which was recognized as vital to industrialization.

Accordingly, a Regional Seminar on Machine Tools for Europe and the Middle East was held in Bulgaria in 1971. This was followed by a Seminar on Machine Tools for Latin American Countries held at Buenos Aires, Argentina (16–25 October), and São Paulo, Brazil (26–27 October), in 1972.

The Seminar in Latin America was held under the auspices of the United Nations Industrial Development Organization (UNIDO) in co-operation with the Government of Argentina through the National Institute for Industrial Technology (INTI), the Chamber of Manufacturers of Machine Tools of Argentina (CAEMHA) and the Government of Brazil through the Conselho de Desenvolvimento Industrial, Rio de Janeiro, and the Federation of Industrialists of the State of São Paulo (FIESP).

The Seminar was attended by 58 participants and 32 observers from 20 countries, namely, Argentina, Bolivia, Brazil, Czechoslovakia, Chile, Colombia, Ecuador, the Federal Republic of Germany, France, Hungary, Italy, Mexico, Paraguay, Peru, Portugal, the United Kingdom of Great Britain and Northern Ireland, the United States of America, Uruguay, the Union of Soviet Socialist Republics and Venezuela.

Among the participants from industrialized countries were representatives of the European Committee for the Co-operation of Machine Tool Industries (CECIMO). CECIMO represents 1,500 manufacturers in 13 European countries whose combined output totals about 40 per cent of the world machine-tool production. CECIMO members and participants from other industrialized countries bore their own participation costs and presented papers on the various subjects of the agenda free of charge. CECIMO reaffirmed its willingness to assist the countries of the region and UNIDO in their future activities in this field.

The Seminar was also attended by a representative of the Economic Commission for Latin America (ECLA), who presented a paper on the status of machine tools in the countries of the region.

The purpose of the Seminar was to examine and analyse, through papers, films, discussions and factory visits, the technical and economic problems involved in the selection, production, utilization, maintenance and repair of machine tools, as well as in the establishment

Participants visit plant manufacturing automatic transfer machine tools in Argentina.

and development of the machine-tool building industries in countries of the region.

Papers were presented by leading experts in this field, by UNIDO, and by other participants in the Seminar. The presentation of each paper was followed by detailed discussions which laid stress on the special conditions prevailing in the countries of the region in general and those represented at the Seminar in particular.

The programme included visits to major factories of the metalworking and machine-tool industries in Argentina (Buenos Aires and Córdoba) and Brazil (São Paulo, Jundiaí and Sta. Bárbara do Oeste). These visits were organized by the Governments and industrial chambers and federations of the host countries, so that the group might study the application, utilization and manufacture of machine tools under workshop conditions.

A visit was also made to the premises of INTI at Buenos Aires where valuable information was obtained about the Institute's activities supporting the technological development of the metalworking industry in Argentina.

INTI has established research and development laboratories in the fields of physics (electricity, electronics, basic metrology etc.), chemistry (organic, anorganic, chromotography etc.) and material analysis (destructive and non-destructive testing, industrial treatment for metal, plastics, paper etc.). The findings of these laboratories are at the disposal of manufacturing enterprises in Argentina.

As a result of the Seminar, areas where UNIDO might provide technical assistance have been identified for ten countries of the region and useful contacts have been established between interested parties from the Andean Group countries (Bolivia, Colombia, Chile, Ecuador and Peru and industrialists from Argentina, Brazil, European countries and the United States of America. These contacts, it is expected, will lead to industrial co-operation which will help the member countries to fulfil their obligation to develop their metalworking industries in accordance with the Group's Industrial Development Plan.

It was the unanimous view of the participants that the Seminar had been useful to both developing and developed countries, as many direct contacts had been established that might lead to mutually beneficial commercial and technical arrangements.

The third in this series of UNIDO seminars will be held in September 1973 at Tbilisi, Georgia, USSR. It will deal, on a regional basis, with the developing countries of Asia and the Far East and will be held in co-operation with the Economic Commission for Asia and the Far East (ECAFE).

BOOKS

Recent publications reviewed by IRDN

Aktuelle Fragen Ausländischer Investitionen in Lateinamerika—Information und Diskussion, in: Private Auslandsinvestitionen in Lateinamerika

by Albrecht von Gleich. Institut für Iberoamerika-Kunde, Hamburg 1971, 104 pages.

Foreign investment has long been a major topic in developmental economics. However, whereas in the past, economists discussed mainly ways of improving the so-called investment climate, the flow of capital between industrialized and developing countries etc., attention is now focused on analysing the structure, motives, mechanism and effect of foreign investment in these countries. This enlargement of the topic is closely related to the reappraisal of the role of foreign capital in the economy of developing countries, the reorientation of technical assistance in accordance with new trends in the world economy and, especially, the enhanced role and impact of multinational corporations in world production and trade. It is widely recognized that foreign investments and aid have impact on the socio-economic and political structure of the recipient countries and discussion nowadays focuses on measures to control and reorient such investments with a view to increasing their contribution to the development of these countries.

The book under review is a summary of the papers presented and discussions that took place at the International Conference on Problems of Foreign Investments in Latin America, which was held in Hamburg on 13 and 14 October 1971. The meeting was organized by the Ibero-Amerika Verein, the Institut für Iberoamerika-Kunde and the Deutsche Stiftung für Entwicklungsländer. It was attended by representatives of official institutions and the private sector in Latin America and the Federal Republic of Germany and by representatives of inter-American institutions and the Economic Commission for Europe.

In a paper presented by the Economic Commission for Latin America (ECLA) it is stressed that direct foreign investment has brought about an increase in the productive capacity of Latin America. This is particularly the case where big industrial enterprises have established branches with the most up-to-date production techniques. Foreign capital has contributed also to the consolidation and enlargement of the infrastructure in this part of the world. However, serious problems, such as pressures on their balance of payments, constantly increasing foreign indebtedness and an ever stronger external dependence, have also been created for the recipient countries.

Foreign direct investments are concentrated in the dynamic branches of industry that have growth rates of productivity and output much higher than those in the traditional sector. This leads to a considerable reduction in the import capacity of the recipient country and to a replacement of the goods manufactured in that country by more competitive foreign products. Besides, foreign enterprises in Latin America manufacture mainly for the domestic market: in 1965 only 7 per cent of industrial output was exported. In other words, the share of foreign enterprises in the expansion of exports is insignificant. This runs counter to the aspirations of Latin American countries to increase considerably their exports of manufactures. There is also a considerable outflow of capital from Latin America. During the sixties, transfers of profits and interest amounted to $18.1 million. Net capital inflow—including net inflow of credits, direct investment and grants—amounted to $17.5 million for the same period (p. 12).

A paper by Jesús Sabra of the Ministerio de Relaciones Exteriores y Culto, Buenos Aires, concentrates on another important aspect—equity joint ventures—which the author considers necessary in cases of complex technology and technological innovations. However, he is opposed to new foreign investments that end up in the takeover of Argentinian national firms, because of the "unfavourable effects on the balance of payments and the political and psychological consequences which lead to the creation of an unfavourable investment climate, even for such investments which are important for the development of the national economy" (p. 30).

In this respect it is particularly interesting to note the paper of Germánico Salgado, written on behalf of the Andean Group, which takes a much more critical stand on the role of foreign capital in the economic development of developing countries. Speaking about integration among developing countries, he emphasizes that the fruits of such integration should be reaped by local enterprises. This does not imply discrimination against foreign enterprises. It means only that "the local enterprise by its very nature belongs to the national community, shares its objectives and is subject to its limitations. The foreign enterprise, with all its advantages, belongs to a foreign entity whose objectives are different. It is led by its own management, in accordance with world-wide general criteria, with world-wide business policies under which each of its branches and subsidiaries is only part of the global whole, and is managed as a function of this whole. For this reason it seems absolutely normal . . . that through the common regulation of foreign investments in the Andean Group this new integrated area should function mainly with a view to strengthening the national enterprises" (p. 56).

In conclusion, the Andean Group countries need foreign investment. However, this investment should take place on the basis of clear-cut agreements that enable local enterprises to develop, and gradually take over, foreign branches when they are capable of their own development. This substitution of local enterprise for foreign investment will be a continuous process in which the possibility will always exist for profitable investments by foreign capital.

The main conclusions and recommendations of the Conference were summed up, as follows, by Mechthild Minkner of the Institut für Iberoamerika-Kunde, Hamburg:

> As a supplementary source to internal capital formation, in the transfer of technology and know-how, foreign investment can give an important impetus to development.
>
> In spite of the reduction in foreign investments, in comparison with gross internal investment, the influence of such investments is, in many instances, decisive. Foreign investment, to whatever degree, is managed from abroad, and this, in the past, has led to such an outflow of capital and foreign exchange from the recipient countries as to cast doubt on the positive contribution of the foreign investment to development.
>
> The conflict between donor and recipient country, with respect to foreign investment, manifests itself in different ways: it depends not only on the level of development of the recipient country but on the structure of the foreign investments.
>
> In recent years, an increasingly critical attitude towards foreign investment in the Latin American countries has been coupled with direct or indirect action and legal measures designed to guide investment in accordance with the donor's own development aims. Thus, views differ, and controversies arise frequently, on the aims of, and measures to be taken between, official and private interest groups (pp. 62, 63). However, a general rapprochement and harmonization of the different points of view is being greatly facilitated by the fact that in the past few years fundamental changes have begun to take place in the Latin American countries. They consist of changes in the political structure, in the objectives of development, in integration aspirations, in the foreign trade position, and in the concepts and attitude towards foreign investment. The Latin American countries are eager to rid themselves of their image of exporters of raw materials and to industrialize rapidly on the basis of new technology, while preserving their economic independence.

This book is a helpful guide to taking a new look at, and revising an approach to, the role and problems of foreign investment—not only in Latin America, but in the other developing regions of the world.

The Wealth of India: Industrial Products—Part VII (Series Pl—Sh)

by the Council of Scientific and Industrial Research, New Delhi, India, 347 pages

The industrial products mentioned in this series cover a broad spectrum such as plywood, potassium compounds, power and electrical manufactures, printed matter, processed fruits, vegetables and meat, pumps and power-driven apparatus, refractories (including those for metallurgical and steel industries), milled rice, salt, and sewing machines. The entries are in alphabetical order. Although the ambivalance between many product areas may strike the reader as being at variance with normal practice, once he becomes used to the style of presentation, he has the key to valuable data concerning Indian raw materials and their processing techniques—data that is of immense value to both layman and specialist alike.

The publication includes Indian standards for raw materials, industrial products, and quality control.

In order to comprehend fully the value and the usefulness of the publication, believed to be the first of its kind anywhere, it is necessary simply to go through the chapters on refractories and rare earths. The flow-sheet given for the extraction of rare earths from monazite in the heavy beach sands of India and the recovery of individual rare earth metals provide the reader with handy reference material for further studies and investigations. An interesting introduction to the metallurgy of rare earths and the preparation of the metals from them is given. The text contains references to Indian and overseas authors. The refrigeration, air conditioning, rice milling, and rubber industry are similarly treated.

The publication lacks references to the chain of national research laboratories and institutions set up by the Council of Scientific and Industrial Research during the last few decades, which strikes the reader as somewhat odd, since the publication itself was prepared by the Council.

The publication is well edited and contains a complete bibliography. An acknowledgement of its value was made by the late Prime Minister, Jawaharlal Nehru, who stated:

"I have found this dictionary fascinating and it has opened out vistas of thought to me.

I have no doubt that this book, produced by many scholars and experts and after much labour, will be of great value to the builders of new India".

The Wealth of India could serve as an example for other developing countries.

Investing in developing countries

by the Organisation for Economic Co-operation and Development (OECD), Paris, 120 pages

This study lists the incentives provided by each member country of the Development Assistance Committee of the OECD to encourage foreign private investment in the developing countries. Private investment is understood as covering direct or portfolio investment but not private export credits.

The facilities offered by governments to private investors, described in the study, fall into five categories:

Investment guarantee schemes covering "political" or "non-commercial risks"–that is, risks outside the investor's control and for which no commercial insurance is available;

Fiscal provisions for investment income from developing countries;

Information and promotion activities, particularly the financing of pre-investment and feasibility studies;

Co-operation between government aid agencies and private investors;

Government-sponsored investment corporations.

The existing incentive programmes vary to a large extent from one country to another. The Federal Republic of Germany, Japan and the United States of America have, for some time, been offering a relatively broad range of facilities to investors in developing countries. A trend in favour of incentives for private investment in developing countries has recently appeared and this has been reflected in particular in an extension of investment guarantee schemes.

In addition to detailed country information, the OECD study contains a table summarising all the guarantee schemes for overseas direct investment and the main measures taken during the past few years to improve the investment climate.

Encyclopedia of Instrumentation and Control, Douglas

M. Considine, Editor-in-Chief, McGraw-Hill Book Company, New York, 1971.

The compilation of up-to-date material from numerous contributors for an encyclopaedia on such a diversified and constantly growing field as instrumention and control technology is a formidable task and the editors deserve credit for undertaking it. Most of the entries, which are well selected to cover the complete field, are treated in a concise, thorough and professional manner.

However, owing to the fact that the many contributors come from various echelons of research, production and management, not all topics are treated in equal depth. In particular, the inclusion of more theoretical and mathematical background information would have been appreciated. For instance, stability criteria and optimization procedures for control loops should be found in this type of book. Some entries such as servos and servo-mechanisms are brushed over very lightly, with just a few lines of text each. Information on a number of instruments is limited to a description of available hardware. If this is restricted to a single model made by the contributor's company, it may create the impression that there is no other way to build, for example, a hygrothermograph. The otherwise excellent treatment of thermometers and temperature measurement fails to mention the existence of bi-metalli indicating thermometers, which are mass-produced the world over. Information on thermography is limited to a translation of the term into English, without a word on relevant instrumentation. Several similar cases could be cited.

Nevertheless, these few shortcomings do not seriously limit the usefulness of the Encyclopedia. Literature references are given throughout the text for more detailed study and the purpose of the book, as stated in the preface, to provide initial orientation on each topic, has certainly been achieved. The Encyclopedia will also be a valuable source of reference for the design engineer who will find it most useful in his personal library.

Economic Growth of Colombia: Problems and Prospects

Dragoslav Avranovic, Editor. John Hopkins University Press, 1972.

This country economic report, by the staff of the International Bank for Reconstruction and Development–sometimes called the World Bank–and independent experts, was prepared primarily as part of an evaluation study on the Bank's operations in Colombia. The depth of the report, however, and its wide coverage of the Colombian economy extend its usefulness to a wider public. As the title suggests, national economic and sectoral industrial problems, such as unemployment, future availability of foreign exchange, rural and urban development, are treated. It contains information on not only major economic sectors such as agriculture, industry, infrastructure and finance, but also on such subjects as education, training and national health. Statistical data, however, have been collected from established sources and no major effort seems to have been made to collect them from primary sources.

The report begins with the introduction of a "requirement model", in which essentially target growth rates of gross domestic production, capital and export requirements are related. This is a highly aggregate model but it provides a framework for the analysis of a developing economy. It is not, however, utilized in subsequent analyses of various economic sectors and problems, the natural consequence, perhaps, of the involvement of too many experts. Again, while there is no doubt that each main problem is well presented and studied, this volume does not propose a unified approach to economic development and, with the exception of a passing remark on page 115, no reference is made to the distribution of income and its effect on economic development.

Six chapters are allocated to the discussion of manufacturing, the current industrial structure, measures taken by the Government, and studies on the steel, pulp and paper, and chemical industries. These industrial studies provide sufficient information on specific commodities to attract the serious attention of potential investors in Colombia.

In summary, this volume is valuable as a source of information for the student of Colombian economy, and as an excellent case study for the student of economic development in general.

Reliability Guidebook

The Japanese Standards Association, August 1972, 136 pp.

This guidebook constitutes a major addition to the international literature on industrial product reliability and standards. The original Japanese version was written by a team of experts, who incorporated in it the latest Japanese developments and experiences in reliability engineering. The book makes interesting reading for quality control engineers. It is also ideal for courses in industrial engineering or business administration. Although the illustrations are mostly Japanese, the concepts are time-proven and the materials are easily adaptable to situations in other countries.

The contents of the book, which was translated by the Asian Productivity Organization with the permission and support of the Japan Standards Association, include: What is reliability? ; Problems in connection with reliability; Reliability after shipment; and Managing reliability activities.

Manual on Plant Layout and Materials Handling

Economic Development Foundation, 80 pp.

This manual is useful primarily to managers who need an over-all view of the subject in order to detect or improve weak points in the layout of their plants. It presents easy-to-follow procedures for both general and detailed layouts and discusses tools and techniques that can be advantageously employed in a chosen layout. Variable factors such as material, machinery, and personnel, which affect the basic layout, are analysed and explained. Materials handling is also considered.

UNIDO publications in 1972

United Nations publications may be obtained from booksellers and distributors throughout the world, or direct from United Nations, Sales Section, New York or Geneva.

Manual on the Establishment of Industrial Joint-Venture Agreements in Developing Countries, 76 pages.

Pocket guide for drafting an agreement to establish a joint-venture company. Specimen clauses covering various legal points are included. Sales No.: E.71.II.B.23; $1.75

Industrial Research Institutes—Guidelines for Evaluation, 81 pages

Suggests procedures for measuring the performance of a research institute—one of the newest instruments for promoting industrial growth. Uses both quantitative and qualitative approaches. Sales No.: E.71.II.B.22; $2

Perspectives for Industrial Development in the Second United Nations Development Decade: The Textile Industry, 47 pages

Succinct survey and forecast of textile production and consumption in developing and developed countries. Sales No.: E.71.II.B.14; $1

Extraction of Chemicals from Seawater, Inland Brines and Rock Salt Deposits, 59 pages

The most concise guide one is likely to find to the practice of brine technology and the industries dependent on it. Sales No.: E.71.II.B.25; $1.50

Clay Building Materials Industries in Africa, 24 pages

This publication gives conclusions, recommendations and summaries of lectures presented at a workshop held in Tunis. Sales No.: E.71.II.B.24; $.0.50

Guidelines for Project Evaluation, 383 pages

A detailed, scholarly and practical guide to the realities and true costs of national economic development. For economists, industrial planners, financial institutions, government departments and universities. Sales No. E.72.II.B.11. $8.50 clothbound, $2.95 paperbound

Manufacture of Telecommunications Equipment and Low-cost Receivers, 96 pages

Surveys state of communications in the developing countries and prospects for making equipment there. Covers technology, tariffs, training and trading. Of interest to buyers, sellers and makers of equipment and components. Report of meeting, including list of participants and addresses. Sales No. E.72.II.B.3; $1.75

Production of Fish-protein Concentrate, Part II, 170 pages

Perhaps the most comprehensive volume on this vital topic. Covers fish-processing methods from the most ancient to most modern. For technicians, fish processors, nutritionists and investors. Proceedings of an expert group meeting. Sales No. E.72.II.B.1; $3

Production of Panels from Agricultural Residues, 37 pages

Review of background, raw materials, economics and processes for building with straw. For building-products makers, a guide to unusual approaches. Report of an expert group meeting. Lists participants and their addresses. Sales No.: E.72.II.B.4; $1

The Development of Engineering Design Capabilities in Developing Countries, 71 pages

Successful industrial growth depends largely upon indigenous capacity to create and develop engineering design as well as to adapt designs of products to fit domestic needs. Report of an expert group meeting discussing various problems and making recommendations for developing and developed countries. Sales No.: E.72.II.B.2; $1.50

Industrial Development Survey, Vol. IV, 170 pages

Noting that there is an apparent tendency for industrial growth in developing countries to slow down, this volume reviews developments in the First United Nations Development Decade, including output growth, international trade, employment, productivity and investment in manufacturing. The multiplicity of relationships between industry and the agricultural sector is also covered. Sales No.: E.72.II.B.15; $3.50

The Development of Management Consultancy in Latin America, 27 pages

Inadequacies of past and present practice and positive plans for improving consultant services. Consulting firms and individuals need it. Report of a meeting. Lists participants and their addresses. Sales No.: 72.II.B.20; $1

Effective Use of Machine Tools and Related Aspects of Management in Developing Countries, 78 pages

A pocket-guide to setting up and running a machine shop from choice of methods through production management to product quality control. Emphasizes special problems to be found in developing areas. Sales No.: 72.II.B.6; $1.75

Copper Production in Developing Countries, 64 pages

Valuable for its statistics on copper production, consumption and prices, highlights of industrial trends, latest processes and representative national industries. Also useful to researchers, editors, middle-level management in industry and government. Report of a seminar. List of participants and their addresses. Sales No.: 72.II.B.13; $1

Industrial Location and Regional Development, Vol. II

This and Vol. I form the proceedings of an interregional seminar held at Minsk, USSR, in 1968. Vol. II contains selected papers on experience in the USSR. Data on individual regions of the USSR applicable to developing economies. Of interest to regional planners everywhere. Both volumes issued as Sales No.: 71.II.B.18. Vol. I: 700 pages, $12. Vol. II: 32 pages, $1

Regional Seminar on Machine Tools in Developing Countries of Europe and the Middle East, 89 pages

Country reports give good statistical and evaluative summaries of industry in these countries. How-to data for setting up an industry and useful check-list for entrepreneurs. Report of a seminar. List of participants and their addresses. Sales No.: 72.II.B.22. $2

A Fancy Leather Goods Factory for Developing Countries, 35 pages

How to set up a plant for making handbags, wallets and belts. Sales No.: 72.II.B.25; $1

The Motor Vehicle Industry, 86 pages

Detailed review of this industry's present status and future potential in developing countries. Discusses problems, their causes and cures. Many tables, charts and other data. For automotive makers, dealers, exporters, importers, financial agencies and others concerned with this most important industrial sector. Second in a series of publications entitled "Perspectives for Industrial Development in the Second United Nations Development Decade". Sales No.: 72.II.B.17; $1.50

The following publications may be obtained free of charge from The Editor, IRDN

Summaries of Industrial Development Plans, Volume II, 441 pages

Readily usable information on the industrial development plans of seven developing countries. Covers the first part of the Second United Nations Development Decade. UNIDO/IPPD.54

Thesaurus of Industrial Development Terms, 227 pages

Libraries subscribing to Industrial Development Abstracts need this newly issued guide to UNIDO standard terms. UNIDO/LIB/SER.C/1

Functions and Activities of UNIDO

Basic information supplemented by photos, charts and diagrams on the organizational structure of UNIDO and how it carries out its programmes. ID/14/Rev.1

Information Sources on the Meat-processing Industry, 58 pages

First of a series of *Guides to Information Sources*. Lists international and national associations, publications, special documents and miscellaneous sources. Introduction in French, Russian and Spanish. Particularly useful to libraries, publishers, meat processors and those interested in that industry. UNIDO/LIB/SER.D/1

Information Sources on the Cement and Concrete Industry, 100 pages

Second of a series of *Guides to Information Sources*. Lists associations, publications, special documents and miscellaneous sources at world-wide and national levels. Introduction in French, Russian and Spanish. Particularly useful to industrialists, investors, building contractors, engineers and documentation centres serving developing countries. UNIDO/LIB/SER.D/2

New Perspectives in Management Development, Monograph No. 1. Innovations in Management Organization, 11 pages

There is reason to believe that recent innovations in management practice may be more easily introduced in the developing world than the traditional form of management. This booklet discusses "free-form" management, case histories, and results of a recent management survey conducted by UNIDO. PI/31

Procurement of Equipment and Services for UNIDO Field Projects, 8 pages

Describes the work of the Technical Equipment Procurement and Contracting Office (TEPCO), which purchases technical equipment and supplies, arranges deliveries, maintains inventories of material in the field and awards contracts to firms in order that UNIDO can carry out technical and pre-investment projects. PI/19

UNIDO's Special Industrial Services Programme, 7 pages

Describes the work of the Special Industrial Services, which supplements other United Nations industrial development activities by providing short-term and emergency aid to developing countries wishing to solve urgent unforeseen technical problems. PI/20.

Information Sources on the Leather Goods Industry, 80 pages

Third in the series *Guides to Information Sources*. Introduction in English, French, Spanish and Russian. Lists sources by country and type, including associations, publications, special documents etc. Useful to investors, libraries, research and documentation centres and anyone engaged in the leather trades. UNIDO/LIB/SER.D/3

The Programme of the Industrial Management and Consulting Services Sections of UNIDO, 7 pages

One of a series of descriptive brochures on UNIDO's programmes. Discusses types of management aid offered to developing countries and how to ask for such help. PI/33

Industrial Development Abstracts

Key to a wealth of data, background and information. UNIDO/LIB/SER.B/1–11

Industrial Development Abstracts, Cumulative Index, 72 pages

UNIDO/LIB/SER.B/4

Information Sources on the Furniture and Joinery Industry, 93 pages

Fourth of a series of *Guides to Information Sources*. Lists associations, publications, special documents and miscellaneous sources at world-wide and national levels. Introduction in English, French, Russian and Spanish. Useful to libraries and documentation centres, manufacturers, entrepreneurs and others concerned with the industry. UNIDO/LIB/SER.D/4

UNIDO Newsletter, Nos. 45–56.

General publication reporting on UNIDO activities. Lists new publications, meetings, programmes, contracts and positions open. Published monthly in English, French, Russian and Spanish.

Meetings

1973

American Welding Society Annual Meeting and 1973 Welding Show

Chicago, Illinois, 2–6 April. Mr. F. Krisman, American Welding Society, 2501 NW 7th Street, Miami, Florida 33125, United States of America.

Conference on Programming Languages for Numerically Controlled Machine Tools (PROLAMAT 73)

Budapest, 10–13 April. National Organisation of Commerce, PROLAMAT 73, P.O. Box 63, Budapest 112, Hungary.

Offshore Technology Conference

Houston, Texas, 29 April–2 May. Mr. S. Houston, Offshore Technology Conference, 6200 N Central Expressway, Dallas, Texas 75206, United States of America.

American Chemical Society, Division of Rubber Chemistry Meeting

Detroit, Michigan, 1–4 May. Mr. F. M. O'Connor, Harwick Chemical Corporation, 60 S Seiberling Street, Akron, Ohio 44305, United States of America.

Pulp and Paper Industry Technical Conference

Jacksonville, Florida, 1–4 May. Mr. C. E. Green, St. Regis Paper Co., Gulf Life Twr., Jacksonville, Florida 32207, United States of America.

American Institute of Industrial Engineers, 25th Anniversary Conference and Convention

Chicago, Illinois, 23–25 May. Mr. J. M. Weber, Technical Services Director, American Institute of Industrial Engineers, 25 Technology Park, Atlanta, Norcross, Georgia 30071, United States of America.

Conference on Systems Approaches to Developing Countries

Algiers, 28–31 May. Mr. Y. Mentalechta, Commissariat à l'Informatique, 4 boulevard Mohamed V, Algiers, Algeria.

Fourth Canadian Congress of Applied Mechanics (CANCAM 73)

Montreal, 28 May–1 June. Mr. A. Biron, Head, Division of Applied Mechanics, Central Committee for Canadian Congress of Applied Mechanics, Ecole polytechnique, 2500 Marie-Guyard, Montreal, Canada.

Ceramic Materials Conference

Baden-Baden, Federal Republic of Germany, 3–6 June. Mr. N. J. Kreidl, Ceramic Engineering Department, University of Missouri, Rolla, Missouri 65401, United States of America.

Eleventh Conference on the Silicate Industries

Budapest, 4–8 June. Mr. Tamas Ferenc, P.O. Box 240, Budapest 5, Hungary.

International Gas Union, Twelfth International Conference

Nice, 5–9 June 1973. Mr. H. Descazeaux, International Gas Union, Rue de Courcelles 62, 75-Paris 8e, France.

Fourth International Symposium: Fresh Water from the Sea

London, 11–14 June. Mr. A. Delyannis, Institute of Chemical Engineers, P.O. Box 1199, Omonia, Athens, Greece.

Applied Mechanics Conference

Atlanta, Georgia, 20–22 June. Mr. A. B. Conlin, Jr., Director, Technical Departments, American Society of Mechanical Engineers, 345 E 47th Street, New York, N.Y. 10017, United States of America.

European Meeting of Chemical Engineering/ACHEMA 1973

Frankfurt, 20–27 June. Mr. D. Behrens, DECHEMA, P.O. Box 97 01 46, D6 Frankfurt-am-Main 97, Federal Republic of Germany.

Forest Products Research Society 1973 Annual Meeting

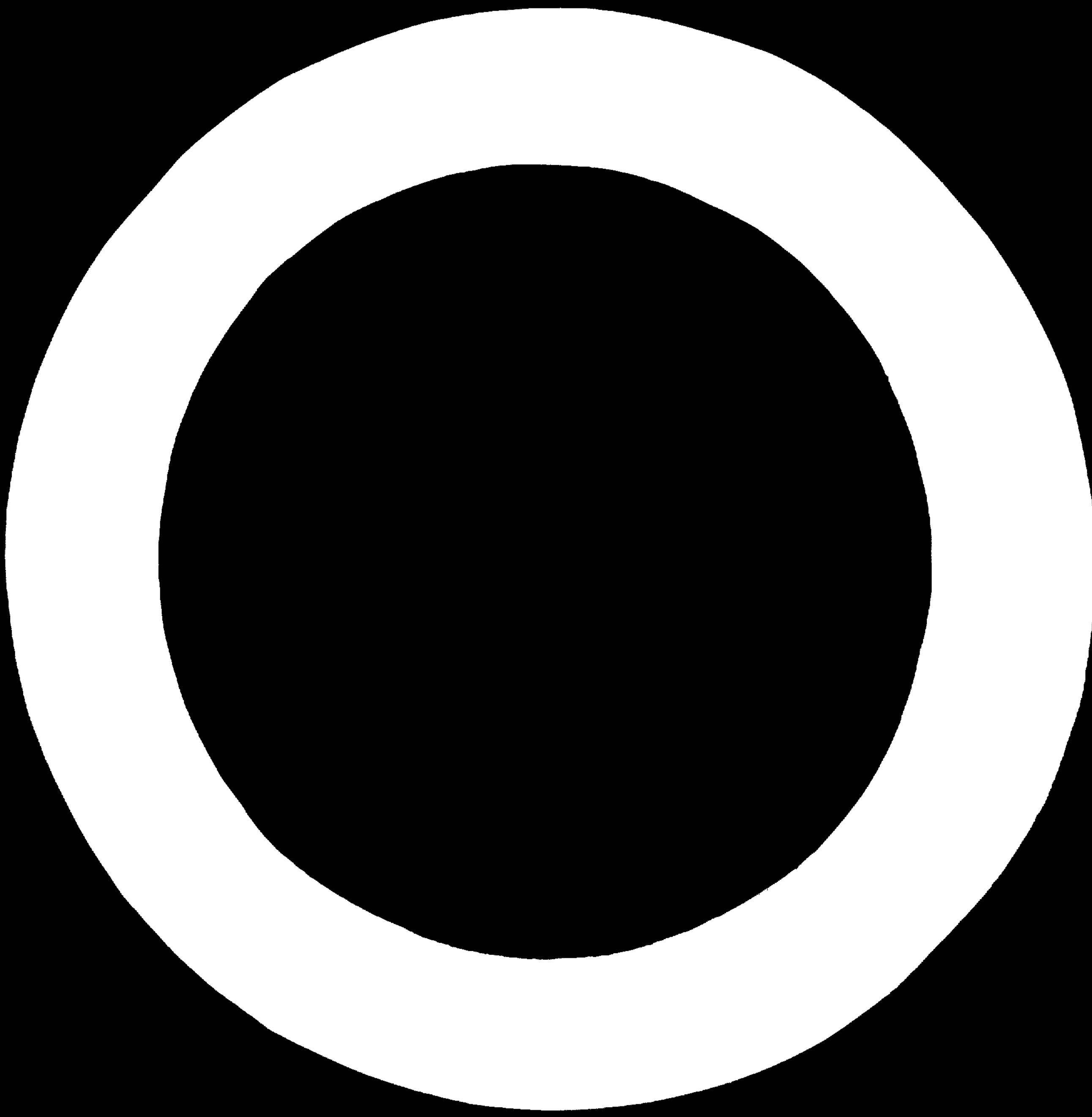
Anaheim, California, 24-28 June. Mr. K. E. Huddleston, Executive Secretary, Forest Products Research Society, 2801 Marshall Ct., Madison, Wisconsin 53705, United States of America.

Meeting on Sampling in the Mineral and Metallurgical Processing Industries

London, 28 June. The Editor, Institution of Mining and Metallurgy, 44 Portland Place, London W1N4BR, England.

International Man-Made Fibers Conference

Dornbirn, June. Mr. R. Katshinka, Austrian Man-Made Fibers Institute, Plosslgasse 8, A-1041 Vienna, Austria.



The Industrial Research and Development News *is published in three language editions, English, French and Spanish. The annual subscription rate for each edition is $U.S. 4.50. Readers in Africa and Europe who wish to subscribe should write to*

United Nations Publications

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CH-1211 Geneva 10
Switzerland

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United Nations Publications

LX 2300
New York, New York 10017
United States of America

Articles to be considered for publication, comments on material published and suggestions for topics to be covered should be sent to:

The Editor
Industrial Research and Development News

United Nations Industrial Development Organization
P.O. Box 707
A-1011 Vienna
Austria.

Printed in Austria
72-6832 – May 1973 – 3,400

Price: $U.S. 1.25 – Annual subscription $U.S. 4.50
(or equivalent in other currencies)

United Nations publication
ID/SER.B/18

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