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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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ACQUIRING TECHNOLOGY FOR METALLURGICAL INDUSTRIES 1/

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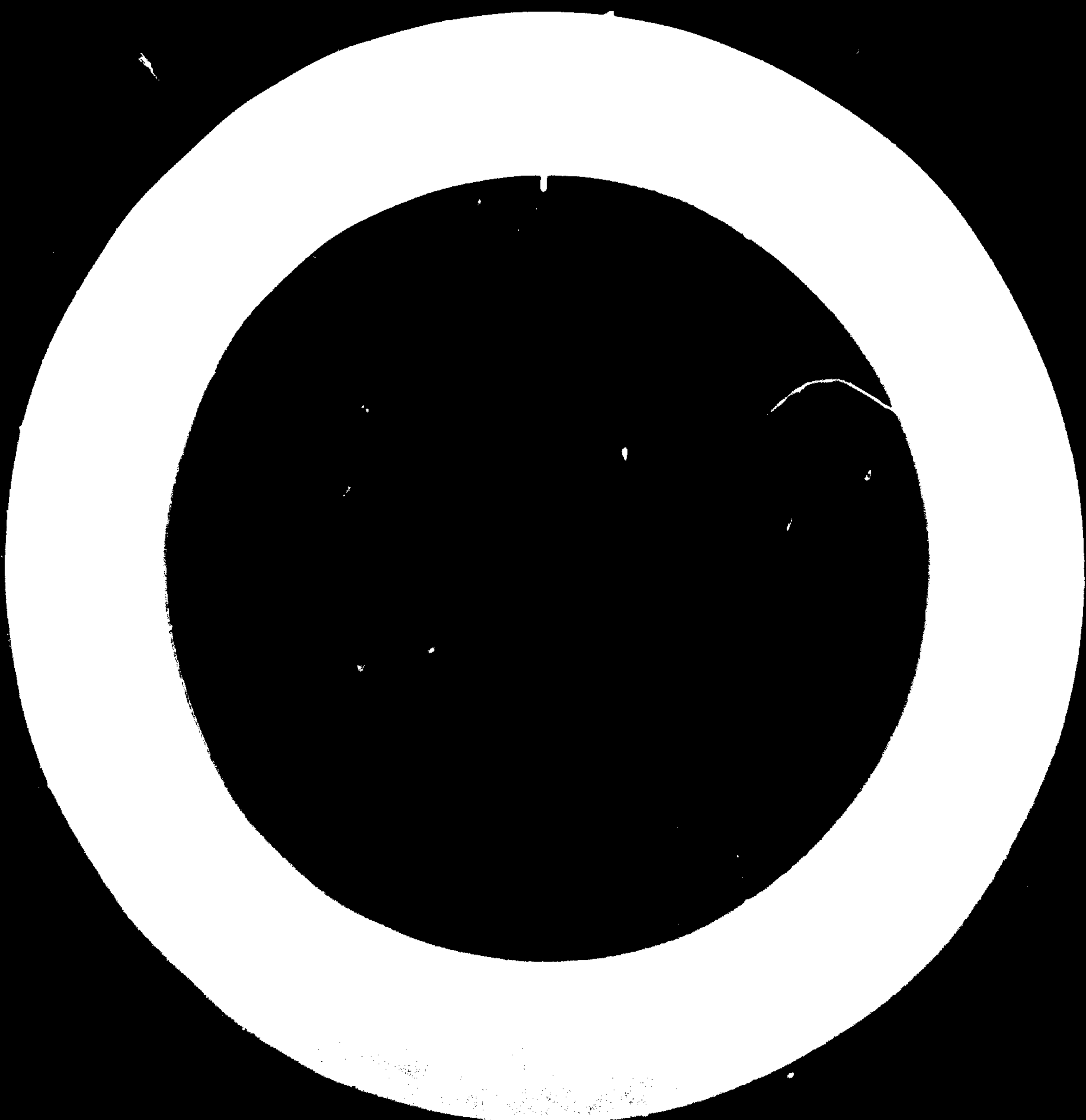

[illegible]

The massive inputs of technology now needed by developing countries for extracting metals from minerals and transforming metals to components call first for policies and instruments to strengthen local technological capabilities. These would include high level skills and facilities for adaptive research and commercialization, engineering consultancy and management of technology transfer.

Concurrently, the inflow of imported technology has to be increased significantly and measures devised to ensure that the recipient gets the right know-how at fair terms while the supplier's interests are also safeguarded. Of the various transfer channels available, the licensing of patented and unpatented know-how has merit for special processes such as the making of alloy steels. The experiences of countries like India and Mexico in know-how acquisition through licensing have pointers for other developing countries.

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Metals have been extracted from ores and transformed to products in what are now called the developing countries since neolithic times. Only 150 years ago samples of 'wootz' steel from India were examined thoroughly by the Royal Society and found to match the best steel then available in Britain. An eminent instrument maker, Stodart, wrote that it was "excellently adapted for the purpose of fine cutlery and particularly for all edge instruments used for surgical purposes... If a better steel is offered to me, I will gladly use it; but the steel of India is decidedly the best I have yet met with."[1]

A systematised metals technology combining practice with theoretical knowledge did not however develop in the developing countries, although practitioners of traditional techniques can still be found. Today when metals are to be produced and fabricated on a significant scale or to special qualities, the know-how has generally to be acquired from abroad.

Dimensions of future technological inputs

Very substantial inputs of technology will now be needed in order to increase the processing of minerals that the developing countries possess. For instance, they hold [illegible] per cent of the world's bauxite reserves and mine 66 per cent, but produce only 6 per cent of the world's aluminium. Two-thirds of global copper ores occur here, but less than one-fourth of the metal is produced. In lead and zinc, the developing countries have [illegible] per cent of total reserves, mine 30 per cent of the world's ores, and smelt only 10 per cent of the metals.

The goal of increasing the Third World's share of manufacturing output from the present 7 per cent of total to 25 per cent by the end of the century [illegible], the processing of minerals [illegible], calls for massive [illegible]

[illegible]

[1] [illegible]

A country like Brazil is estimated to have incurred US$154 million on direct payments for explicit know-how in 1972 and four-times this amount on know-how embodied in equipment, etc. By 1980, explicit know-how imports alone could reach $1 billion at present rates. A comprehensive methodology and action plan have now been formulated by the Government for local production of know-how in order to reduce such imports to possibly about US$500 million.[3]

The metallurgical industry sector constitutes a significant component of the <u>total</u> payments for imported technical services in a developing country. In India, 'metal and metal products' covered 12 per cent of the total number of technical collaboration agreements in the period 1964-70.[4] In addition, 'machinery and machine tools' constituted 24 per cent and 'transport equipment' another 11 per cent. Thus, metal-based industries taken together represent as much as half the total imports.

In developing Asian countries (excluding China and North Korea) steel consumption, for instance, is expected to reach 51 million tons by 1985, against present production of about 10 million tons.[5] Even assuming that only 20 million tons of additional indigenous capacity could be installed, still leaving very substantial gaps, this alone would require an investment of say US$20 billion over the next 10 years. Of this, one could roughly estimate that $3 billion would be in engineering and know-how, $8 billion in equipment and the balance $9 billion in local construction and erection works. The challenge before Asia's steel industry is, therefore, to undertake as much as possible of the engineering and equipment manufacture within the countries (total $11 billion) and acquire the balance at the best possible terms, on the basis of careful evaluation of technological alternatives, and in a manner which would strengthen local capabilities for the future.

3/ L.C. Correa da Silva, Industrial Technology in Brazil: Ideology, Methodology and Action, Management Development Workshop, Instituto de Pesquisas Tecnologicas and Denver Research Institute, Sao Paulo, September 1973

4/ Foreign Collaboration in Indian Industry, Second Survey Report [illegible], Reserve Bank of India, Bombay

5/ Projection 85: World Steel Demand, IISI, 1972

I. KNOW-HOW REQUIREMENTS IN METALLURGICAL INDUSTRIES

A characteristic of the metallurgical industry is that it is capital-intensive. Further, the sale values of its products cover a very wide range. In turn, this does not allow quality or productivity to be sacrificed as may happen in the pursuit of an indigenous technology. What is generally possible, however, is to build on some local capability and supplement it with imported know-how on a selective basis.

Further, extractive processes are sensitive to the composition and other properties of specific raw materials and, as noted earlier, substantial resources are located in the Third World; therefore processes have to be adapted to these peculiarities as also to the available production factors. Local innovative and adaptive talents can play a significant role. 'A thorough knowledge of processes currently in operation and available... is a pre-requisite for conducting an adequate technology transfer negotiation, but it is simultaneously the first step towards starting the creation of local technology.'[5]

For the purpose of this paper, metallurgical operations can be said to cover two main categories - extraction of metals from minerals, primarily by physical, chemical and electrolytic treatments, and metal fabrication/forming to products by processes such as casting, forging, extrusion, coating, etc. In each category, there is a wide range of techniques - from say simple iron founding, at one end, extending to precision metal components requiring complex know-how, at the other.

The know-how often required is for setting up a new metallurgical plant, covering such functions as project design, equipment selection, [illegible], [illegible], and so on. Further, know-how may be [illegible] in an existing plant [illegible].

Typology of metals technology

One could classify metallurgical technologies applicable to developing countries into three types - processes essential for large outputs, technology where scaling down is feasible, and operations where labour could substitute capital:

Inevitable technology: This is typified by the large blast furnace and the wide strip mill which seem to violate all criteria for appropriateness to developing conditions, but are unavoidable if large requirements of a basic material are to be met viably in terms of commercial and often surprisingly also social cost-benefits. (Even here, operations could be disaggregated and more labour deployed outside the core process units.)

Scaled-down technology: The 'mini-steel mill', viable down to capacities of say 50,000 tons per year and with per-ton investment costs of about half the conventional integrated plant, is a classic example. Gaseous direct reduction to produce sponge iron is another. Both these technologies reached maturity in the developing countries themselves. The mini-mill has the added attractions of being able to re-cycle scrap to produce much-needed steel and to consume relatively less energy than other process routes.

In non-ferrous operations, new developments include the application of flash-smelting to copper and lead sulphide concentrates by Outokumpu and other processes, modifications to the shaft furnace to accept fine-sized feed (Momoda furnace), and various hydro-metallurgical processes for treatment of sulphide concentrates.

Capital-substituted technology: Certain extractive metallurgical processes can be modified to save investment by utilising more labour. Ore hearth smelting of high-grade lead ores, electro-refining of copper and desilverization of lead are examples.7/

7/ R.M. Nadkarni, C.L. Kusik and C. Bliss, The Transfer of Extractive Metallurgical Technology to Developing Countries, Workshop on Creation and Transfer of Metallurgical Know-how, UNIDO [illegible], October 1971

In the metal-transforming field, the 6,000 backyard foundries in India represent a unique combination of low-cost techniques to produce grey iron castings with quality acceptable for agricultural implements and ungraded machine tools.[8] The Baranson study on diesel engine manufacture in India mentions the use of sand-moulded castings for oil pans and fly-wheel housings at the Poona licensee (against permanent mould die castings at the parent U.S. plant), and manual labour for assembly, transport, inspection, etc. to substitute mechanical devices.[9] At a tractor plant set up by the Punjab Government, reduction of 30 per cent was achieved on investment plans proposed by prospective foreign collaborators, through elimination of expensive special-purpose machines by detailed production engineering studies to utilise simple machine tools with extensive jigs and fixtures.[10]

The know-how transfer model

The technology acquisition process is not to be viewed as just the act of transfer but as an integrated chain of actions within the framework of national economic, social and technological development plans.

Before the know-how transfer process gets under way, considerable preparatory work is needed. For the extraction of metals from ores, prerequisites would include the analyses of national plans, prospecting of raw materials, studies on overall viability and ecological impacts. A metal processing project would require market analyses, conceptual designs and costing. Only then there is a definition of the broad requirements of technology can the transfer be initiated.

The transfer model itself, like other communication systems, consists of a source (or supplier) which has the knowledge (or message) to [illegible] over [illegible] channels to a receiver in need of this; the [illegible] is to be [illegible] with frequent feed-backs of experience. A [illegible] of the transfer model is shown in Figure 1 on the next page.

[illegible]

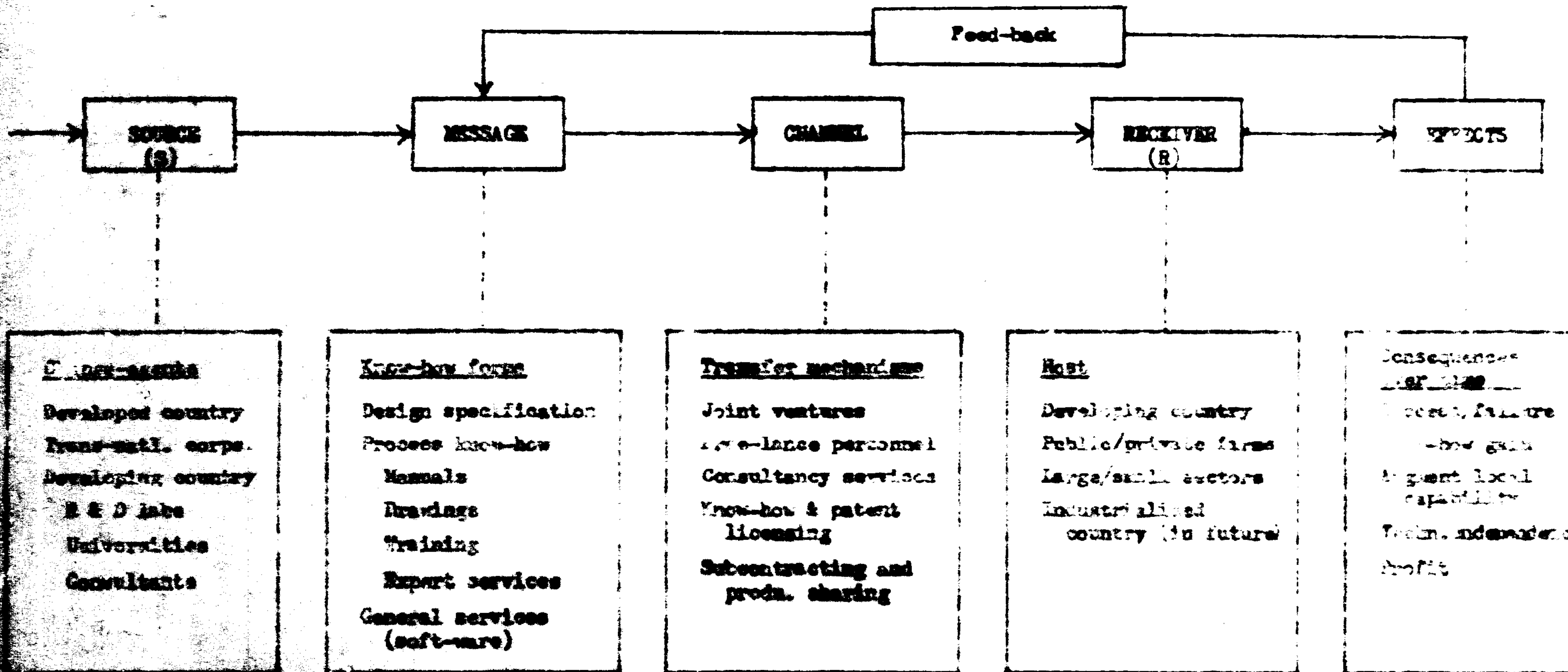

Fig. 1: DYNAMICS OF THE TECHNOLOGY TRANSFER PROCESS

The source may be a production enterprise, consultant, laboratory or agency in an industrialised country, or could well be in another developing country or a group within the country itself.

The know-how message in metallurgical industry systems consists of at least three main components. The first is the process or design specification which delineates the technique or product features by means of drawings and specifications.11/

Secondly, the manufacturing know-how which is required for the actual production operations. This can be transferred partly in the form of working manuals and designs of special devices, tools and fixtures, but primarily through on-the-job training and practical demonstrations. This involves detailed procedures and sequences together with their desired operating parameters. An operator can only absorb these techniques and skills by doing the job with his own hands, following the regimes where specified and using his judgement where required. The know-how transferror may have taken years of trial and error to master these procedures and the primary object of a transfer arrangement is to minimise these development and learning costs.

Finally, there are general advisory services to be provided which cover problems of organisation, management, quality control, marketing, equipment maintenance and materials procurement. Unless technological inputs are complemented by this software, productivity and quality at the best-equipped plant would drop and it could soon come to chaos.

The know-how discussed above may consist of general or established techniques, system-specific procedures which are special to the product or process, and enterprise-specific experience which is unique to the operations of a particular firm.

11/ [illegible]

II. TRANSFER MECHANISMS FOR METALLURGICAL KNOW-HOW

A variety of channels is available to satisfy know-how requirements for planning metallurgical industries and operating them. These are reviewed below before coming to a discussion of know-how licensing as a transfer mechanism.

A. Channels primarily for planning of metallurgical projects

Freely available know-how

The metallurgical journals and meetings of technical societies, often together with plant visits, offer unique opportunities to acquire familiarity with developments elsewhere. A government agency engaged in promoting industries or an individual entrepreneur can develop world-wide contacts to tap this source, provided there is a strong motivation for self-reliance.

A recent study of the metal-working industry in the Philippines has shown that 62 per cent of the plants were planned by the firm's own staff after a study tour and 20 per cent through foreign equipment suppliers. When asked how they would plan their expansions, 34 per cent said they would use their own engineers and 6 per cent would rely on equipment suppliers (15 per cent said they would use foreign consultants and 20 per cent local consultants).[12]

Know-how mounted on equipment

This 'free engineering' can often be very expensive.

A potential entrepreneur may have a vague idea of the product he wants to make and see the equipment that may be needed in an advertisement or in the plant of an existing fabricator; he then contacts an agency house

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[12] R.D. Lalkaka, Technical Consultancy as a Technology Transfer Mechanism, RECAP/UNIDO, June 1974

for technical literature and an equipment quotation. After a personal visit to some plant abroad, he orders equipment with assurances of receiving the embodied operating know-how from the supplier. In some cases this works well, in others the entrepreneur is left with an expensive process line and practically no means to operate it.

The effectiveness of such an arrangement depends largely on the technical ability of the buyer. He benefits to the extent of his absorptive capacity. The equipment supplier covers the cost of know-how, including the research cost for developing the equipment, in the price of the equipment.

Engineering consultancy contracts

Installing a new metallurgical facility and bringing operations up to rated production requires a range of technical services - from planning, design, engineering and construction management on the one hand, to plant operation including management and marketing on the other. A combination of an engineering consultant firm and a plant operating company may be an appropriate source, and has at times been preferred on internationally financed projects.[13]

Generally, an equipment supplier, however experienced, may not be an appropriate agency to provide the project design, the equipment and the operating know-how. Many developing countries have had unfortunate experiences on such turn-key type arrangements. It is generally preferable to unpackage the bundle, to undertake as much of the work using local consultants and services and to import the balance from the best possible sources. If this means additional co-ordination to cope with the divided responsibilities, it may be a cost worth incurring in the interests of securing the most appropriate services and of building future capabilities.

13/ [illegible] in the Planning, Financing, [illegible] Plants, Third Interregional [illegible] Brasil, UNIDO [illegible], [illegible]

B. Channels primarily for operating know-how

Know-how licensing

Know-how contracts, straight patent and trade-mark licences are not common in extractive industries for the production of primary metals as the processes involved are generally well-established. For some of the newer developments, such as direct reduction processes or continuous casting, payments for use of patents with some know-how support are still necessary.

Licensing arrangements for know-how and patents, however, are wide-spread in such special areas as the production of alloy steels and the metal-transforming processes. This transfer channel is discussed in the next section.

General technical assistance

A number of metallurgical enterprises in developing countries have benefited by retainer arrangements which entitle them to consult a reputed manufacturer on specific problems, permit their staff to observe operations at the plant abroad and foreign personnel to spend stipulated time on their plants. The success of such general technical assistance contracts depends primarily on the initiative and curiosity of the recipient.

A fixed annual fee is generally preferable to a per-ton royalty payment (travel costs are normally to the account of the recipient company).

Hiring free-lance personnel (a device often used but seldom publicised)

If a competent individual can be secured, chances are that he would transfer knowledge at a relatively low cost and become quite involved in the success of those hiring him.[14/] On the other hand, a company (as against an individual) could provide an integrated range of services and be held more responsible for its advice, although at a higher cost.

14/ Hiring of developing country professionals has been a mechanism used effectively by the industrialised nations and this reverse transfer of technology has been to the detriment of the poor countries.

The problem, as always, is to find the right individual and create the conditions in which he can give of his best. Developing and publicising a roster of such experts would be a useful task for an international agency.

Sub-contracting

A machine-builder who wishes to off-load the supply of general castings may provide his vendor with the patterns, drawings, materials and methoding know-how. As many as 10,000 small scale units in India are now supplying components and sub-assemblies to 200 large enterprises.[15] Sub-contracting, intra- and inter-national, is becoming a channel of increasing significance.

Materials supplies

A firm promoting a flotation agent or an antiabrasive compound may provide the complete data and know-how on its use.

Industrial service centres

An example is the net-work of Small Industry Service Institutes in India which has helped in transferring better techniques. The chain of Metals Industry Development Centres assisted by UNIDO in the Philippines, Indonesia, Singapore and now Malaysia are providing testing, training and development services in order to up-grade metal industries.

However, satisfactory arrangements have yet to be devised to [illegible] the [illegible] of [illegible] scientific services provided by government [illegible].

[illegible]

not only of innovative work, but also of the adaptation of the imported processes and the up-grading of traditional techniques. At the same time, efforts are needed to commercialize R and D results and transmit them effectively to industry. The flow of technologies from national laboratories and universities backed by technical consultancy services is essential for progress towards self-reliant economies.

Technical information centres

Recent surveys have shown that 75 per cent of the technological needs of small industries are for information on alternative technologies.16/ In the Philippines, the service most requested and used by the metals industry was again technological information. Programmes such as TECHNONET ASIA, which combines information with technical extension for selected Asian countries, the Small Industries National Documentation Centre (SENDOC) at Hyderabad, India, and various international information systems have a catalytic role in the transfer process. UNIDO's Industrial Inquiry Service, for instance, is now dealing with more than 1,000 technological questions annually.

Such transfer agents, however, are more effective (i) in the neighbourhood where they are located,17/ (ii) when information is accompanied by a technical demonstration or extension approach and (iii) when, from its very conception, the system is demand (and not supply) oriented.

C. Channels for both planning and operating know-how

International technical assistance

The above delivery systems operate primarily on an institute-to-enterprise or enterprise-to-enterprise basis. In addition, metals industries in developing countries have benefited through technical assistance, training services and institutional facilities provided by international organizations.

16/ Report of NCST Panel on R & D for Small Scale Industries, Department of Science and Technology, Government of India, [illegible]

17/ 60% of the total clientele of the SENDOC [illegible] service is from Andhra Pradesh where it is located. The TECHNONET [illegible] has been well used in Singapore, [illegible], but [illegible] in Indonesia, a neighbouring participant.

UNIDO has been instrumental in transferring a wide range of metallurgical technologies in the ferrous and non-ferrous fields as well as in creating local metallurgical research capabilities. As an example, the pilot work done under UNIDO auspices for a gaseous direct reduction plant in Iran resulted in the installation of substantial production capacities with accompanying know-how; at the same time, the concern voiced by UNIDO on the solid reductant sponge iron processes has helped developing countries in making an appropriate choice of technology.

Inter-country industrial co-operation

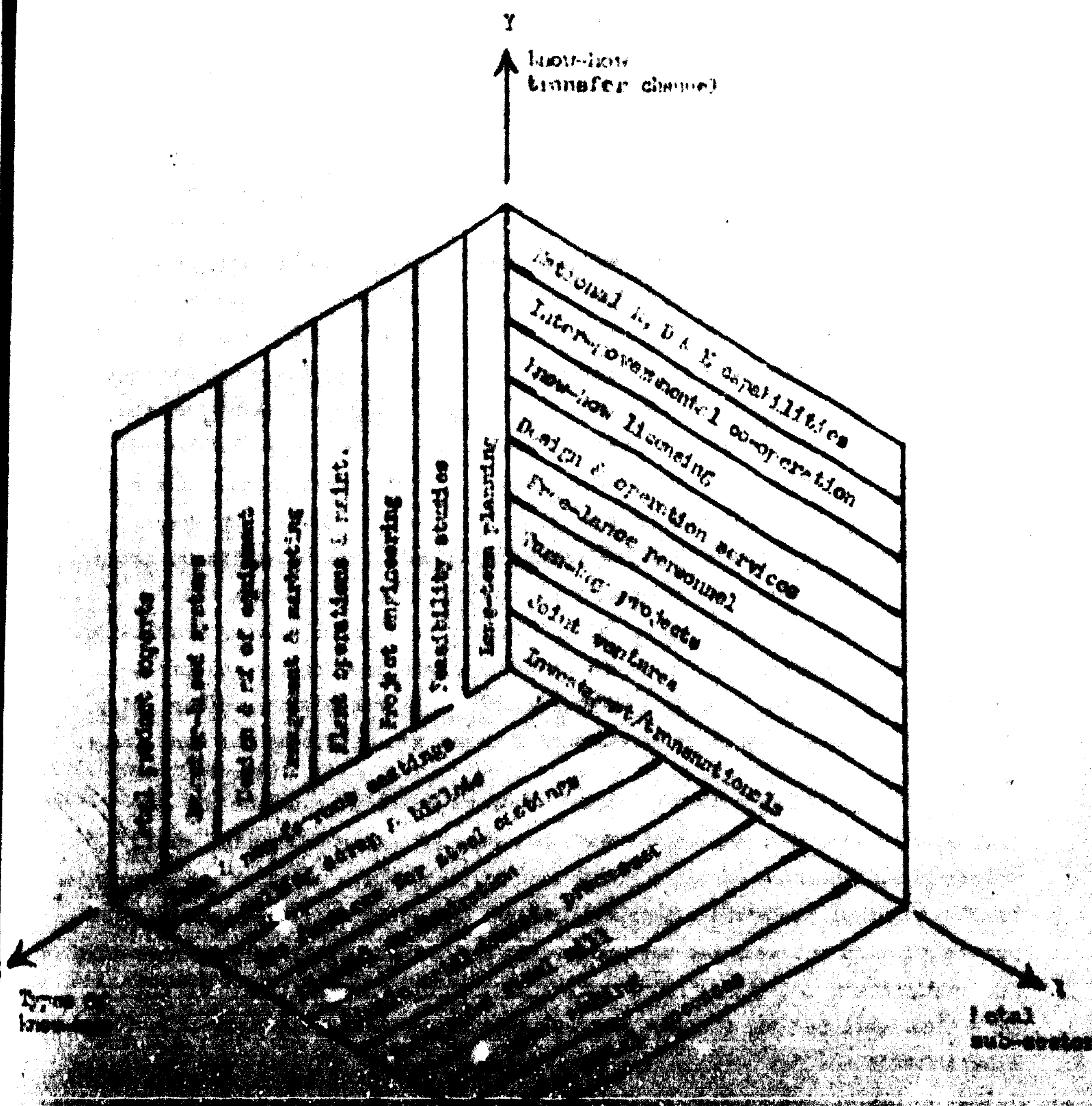
An ECE study[18] states: "The development of industrial co-operation owes much to dissatisfaction with simple licence technology transfers. Besides difficulties in applying licensed technology, and the absence of any commitment on the part of the licensor to the successful application of the technology, simple licensing does not as a rule imply any commitment on the part of the licensor to keep the technology transferred up to date." The study defines industrial co-operation in an east-west context as "the economic relationships and activities arising from (a) contracts extending over a number of years between partners belonging to different economic systems which go beyond the straightforward sale or purchase of goods and services to include a set of complementary or reciprocally matching operations (in production, in the development and transfer of technology, in marketing, etc.); and from (b) contracts between such partners which have been identified as industrial co-operation contracts by Governments in bilateral or multilateral agreements."

[illegible]

transfer agreement provides for visits by teams of planners and technologists from developing countries [illegible] first [illegible] the Indian technology establishment in order to determine the technological co-operation possibilities. At the same time, through the ITEC programme the Indian Government has signed science and technology 'treaties' with a dozen countries on exchange of technical information and personnel. Recent moves by ASEAN to promote industrial co-operation in the steel industry is another example.

The various transfer mechanisms reviewed above require that a choice be made of a device appropriate to the given project and the country's stage of technological development. The benefits of licensing technology from abroad, as against its local development for instance, have to be weighed against costs over the years and opportunities lost, from the national perspective. The methodology of social-cost benefit analyses could well be extended to the technology-transfer decision.

Figure 2 indicates the major transfer channels available, the types of know-how specialisation and typical operations in the steel sector to which these have to be applied. The least developed countries start at the (0,0) point and move outwards along the three axes towards greater industrial sophistication.


Y
Know-how transfer channel
Long-term planning
Feasibility studies
Project engineering
Design & operation services
Free-lance personnel
Turn-key projects
Joint ventures
Investment/Transnationals

[illegible] technology for the [illegible] firms

The problems of transfer to the very small firm in Asia are among the most complex. There is undoubtedly a great deal of native skill and innovation at the shop-floor level, as evidenced by say the manufacture of lathes and planing machines in the open air on a street in Batala, Punjab, without benefit of overhead crane, metal or sand control, or trained engineer. In Laos, one of the least developed countries, a small shop has set up a swords-to-ploughshares operation. utilising sheet scrap from old explosives containers it is producing a variety of shovels and other agricultural implements, capacity 4,000 pieces per day.[20] A Thai entrepreneur has designed simple 2-stroke gasoline engines (7 to 25 HP) and is casting, machining and assembling those at the rate of 500 per month. They are popular because of low cost (20 per cent below comparable imported models), easy maintenance and versatility as prime mover for pumps, boats and hand-tillers.[21] But there are major problems in spreading the technologies which are essential to improve quality, reduce rejections, diversify production, widen its market and indirectly raise living standards of the work force without raising production costs. This technology may exist in enclaves within the country and has to be transferred horizontally in a manner such that it reaches the weaker units and does not convert small entrepreneurs into big exploiters of the work force.

The small firm is not likely to up-grade its wares unless the new technique is demonstrated competently, not once but again and again, and unless it is convinced of clear long-term benefits. Such transfer and absorption require vigorous technical extension services backed by adaptive R and D, possibly government-assisted but preferably also through self-help co-operative associations and consulting firms with small industry orientation. At the same time, this technical effort must be part of an integrated package covering credit facilities for working capital and investment, supplies of raw materials, marketing assistance including export possibilities and sub-contracting, training in management and operating techniques. The Small Industries Development Organisation in India is now implementing such a modernisation programme for selected metals industries.

20/ R.D. Lalkaka, Advisory Services Report to Government of Laos, ESCAP/UNIDO, May 1975

21/ Visit to [illegible] Machine Company, Bangkok, April 1975

In a recent survey of the metals working industry in the Philippines, the difficulty in securing capital was cited as the main problem in acquiring new processes and equipment. With regard to mechanisms for technology transfer, joint venture companies were the first choice. Table 1 summarises the major constraints and preferred means of acquiring know-how in small, medium and large enterprises.

Table 1: Restraints to Technology Transfer and Preferred Channels in Metal-working Firms in the Philippines

	Total		Under 50 employees		50 - 99 employees		100 employees and above	
	No. of firms	% of group	No. of firms	% of group	No. of firms	% of group	No. of firms	% of group
Main constraints to technology acquisition:	61							
1. Government policy	4	6.56	-	-	1	5.26	3	9.09
2. Lack of capital	30	49.18	5	55.56	9	47.37	16	48.48
3. Lack of training	21	34.43	1	11.11	7	36.84	13	39.39
4. Lack of information	14	22.95	2	22.22	7	36.84	5	15.15
5. Cultural problems	6	9.84	-	-	2	10.53	4	12.12
6. Others	9	14.75	2	22.22	2	10.53	5	15.15
[illegible]	127							
1. [illegible]	16	[illegible]	1	11.11	4	[illegible]	11	33.33
2. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7	[illegible]	13	39.39
3. [illegible]	[illegible]	[illegible]	-	-	1	[illegible]	3	9.09
4. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4	[illegible]	[illegible]	[illegible]
5. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

III. [illegible] IN ASIA

Industrial units in Asian countries, both Government and private, have often faced serious difficulties in technical collaboration arrangements. To give some typical instances, in the case of a scooter project the collaborators of a public sector corporation in a developing country changed the model within a year after expensive dies had been procured. This country had the same experience in a diesel engine manufacturing project. In one case the know-how agreement for a machine-tool factory expired before the factory itself was completed. Typical is the case of another firm which located a source for know-how on casting of cylinder heads of special design but the party refused to sell this technology as it was more interested in continuing sales of its castings. It was found in one Asian country that the total monthly cost of maintaining a foreign expert was <u>fifty-times</u> the salary of its prime minister.

Clearly, much needs to be done in removing the obstacles to the flow of technology and in strengthening technological capabilities to ensure that the most-suited processes are developed or acquired, from the right sources, and at equitable terms and conditions.

<u>Absorptive capabilities of recipient</u>

For the know-how licensing channel to be a success, both the supplier and recipient have to meet some minimum requirements.

The capacity of an enterprise to absorb technology is a crucial factor in the effectiveness of transfer. Entrepreneurial abilities and sound technical leadership are needed to help overcome the difficulties endemic in developing countries. Typical of the problems besetting metal-working factories in an Asian country such as the Philippines 22/ are as follows:

<u>Materials</u>: quality of raw and intermediate materials not as specified, erratic availability of imported supplies

22/ Survey by Metals Industry Research and Development Center, Manila, of 120 metal-working firms.

Manufacturing: inadequate heat-treatment facilities, lack of standards, poor quality tools, frequent machine break-downs, lack of skilled operatives

Management : unsatisfactory production scheduling, inadequate management skills, excessive local competition, difficulty of financing/ collecting bills.

Interviews with 61 metal-working firms on aspects of technology acquisition indicated that

95% of the total had less than five engineers
24% had no in-plant training facilities
77% had no R and D facilities.

The inadequate absorptive capacity at the enterprise level is a reflection of the undeveloped industrial infrastructure in a country. This combined deficiency can impair the working of a know-how licensing arrangement, and unless the prospective licensee has a technical base for absorption, he may be well advised to use some other means for acquiring know-how.

Effective [illegible]

The effectiveness of technology transfer depends in equal measure on the [illegible] of the licensor (i) to deploy personnel with [illegible] problems; (ii) to redesign [illegible] (iii) to modify the [illegible] skills and [illegible]

Obviously it is advantageous if the proprietor of the know-how has had previous experience in [illegible] a transferable technology package for use under developing conditions, and the technology gap between the two parties is not excessive. It also helps if he can realise an adequate return on his endeavours. The proprietor, who has spent large sums in acquiring a body of knowledge and skills, sets two basic conditions when considering a licensing project. (i) it should not disrupt some satisfactory business already existing in other countries relating to such technology; and (ii) it should have a reasonable profit potential, at least in the long run".[23] Any significant increase in flow of technology from those who have it to those who need it will depend on efforts to reconcile view-points which are increasingly in conflict.

The essential ambience

The fine print of a lengthy contract document does not necessarily make for a successful transfer - the goodwill both parties bring to bear on the whole undertaking can be a significant contributor. "Making people co-operate who have a built-in prejudice or grudge against each other is simply a non-starter. The selection of unprejudiced men and the prevention of grudges is a point worth considerable effort."[24]

The technical collaboration arrangement has to be flexible because metals technology is changing so rapidly that conditions at the end of the licence period cannot fully be anticipated. Even the most carefully drafted agreement requires a great deal of give-and-take in implementation.

For instance, an Indian enterprise has a joint venture with a Japanese roll maker together with a 10-year know-how licence (royalty 3 ¾ per cent of total good sales). The licensor specified charcoal pig iron for producing clear-chilled rolls but as this material was not available, the joint venture itself developed an alternative process. It has also developed Pilger mill rolls for tube-making, an item not originally [illegible]

23/ R. Goldscheider, Basic Elements of International Licensing Agreements Involving Developing Countries, Regional Seminar on [illegible] Licensing Arrangements, Manila, June 197[illegible], UNIDO ID/WG.17[illegible]

24/ G. Dobos, Technical Consultancy Services and Transfer of Technical Know-how for the Aluminium Industry in Developing Countries, [illegible] on Creation and Transfer of Metallurgical Technology, [illegible] December 1971, UNIDO ID/[illegible] in the know-how licence. But for both the above products, royalty is being paid as the Indian party believes that the loss of goodwill by entering into a controversy may be counter-productive!

Information sources on know-how

While large companies have access to advanced technology, information sources are practically non-existent for small and medium metal transforming units which now seek to improve their product quality, diversify or expand. These units offer good possibilities of much-needed expansion of employment at low per-job investments.

A current UNIDO project is assisting such small and medium-scale firms in developing countries to establish contacts with companies prepared to sell their know-how. A 'portfolio'[25] has been prepared of some 300 typical metal-transforming technologies and this has been widely promoted in 12 countries of Latin America and six countries of Asia, mainly through existing technical associations and local consultants in the countries themselves.

In addition to the interest - and opportunities - this project has created in know-how licensing, it has had other interesting results: for instance, in Bangladesh the portfolio listings are being used to identify techniques needed in the medium-term and long-term and to motivate entrepreneurs to enter these new fields; India already possesses the bulk of the metal-transforming technologies needed and a new compendium of available processes is now to be prepared which will help in their transfer within the country and to other developing countries.

[illegible]

Technical collaboration: the Indian experience

A comprehensive study of foreign financial and technical collaborations by the Reserve Bank of India covered 877 companies in the Indian private sector for the period 1964-70.[26/] Of these 620 companies had know-how arrangements involving a total of 1098 agreements. In addition, 41 government companies had 163 agreements. Metals and metal products covered about 12 per cent of the total agreements.[27/]

Know-how requirements: Analysis of the types of know-how sought by the 'metals and metal products' sector indicates that joint venture companies were confined to selected products such as tungsten carbide and machine screws. Minority participation companies produced rolls, bearings, forgings, welding electrodes and coil springs. Pure technical licensing covered specific items such as tubes, gears, wire ropes and special castings.

Remuneration: Of the 64 agreements in the metals sector, 17 paid royalty at 2.1 to 3 per cent of sales/production value, 11 paid 3.1 to 4 per cent, and 21 paid 4.1 to 5 per cent. This was a similar pattern to average payments for other manufacturing sectors. Of the total remittance of technical fees by all industries (about $28 million in 1969-70), the metals sector represented $3 million. Contract duration was generally between 5 to 10 years.

Restrictive clauses: Three-fifths of the technical agreements had regulatory clauses related to exports, sources of supply, pattern of production, sales procedures and so on. The point to note is that the proportionate incidence of such clauses had increased over the 1960-64 period, particularly regarding export restrictions. Exclusive rights for use of know-how were granted in the majority of cases but the know-how was generally not available for continuous use after the expiry of the agreement. A break-down of restrictive clauses for the metal and metal products as compared to other sectors is given in table 2 on the following page.

26/ Foreign Collaboration in Indian Industry, Second Survey Report 1974, Reserve Bank of India, Bombay

27/ Gross profits as per cent of total capital employed was 5.8 per cent in metals compared to 16.8 in food and beverages, 20 per cent in pharmaceuticals, and 9.8 per cent average for all manufacturing in 1969-70.

Table 2 : Regulatory Clauses in Technical Collaboration Agreements - Industry-wise for Major Categories (1964-70)

[illegible]	[illegible]	Machinery and Machine Tools	Metals and Metal Products	Electrical Goods and Machinery	Chemicals & allied Products: Total (including other chemicals)	Chemicals & allied Products: Basic Industrial	Chemicals & allied Products: Medicines and Pharmaceuticals	Rubber Goods	All Industries (Including others not shown here)
	1	2	3	4	5	5a	5b	6	7
[illegible] 1)	9	8	20	32	6	2	2	1	80
[illegible] 2)	-	-	2	1	1	-	1	-	5
[illegible]	-	3	6	4	5	1	3	-	19
[illegible]	9	11	28	37	12	3	6	1	104
[illegible] 1)	74	163	23	118	38	26	10	1	457
[illegible] 2)	9	3	12	12	3	1	-	-	48
[illegible]	12	37	9	27	13	3	6	2	113
[illegible]	95	203	44	157	54	30	16	3	618
[illegible] 1)	38	188	46	90	22	8	8	8	419
[illegible] 2)	2	7	10	2	6	4	-	-	41
[illegible]	18	31	8	23	15	8	6	4	103
[illegible]	58	226	64	115	43	20	14	12	563

[illegible]: (i) Permission of collaborator for exports; (ii) Prohibition of exports to collaborator's country; [illegible] of exports to countries in which the collaborator operates through branches/subsidiaries/affiliates or [illegible] similar collaboration agreements; (iv) Prohibition of exports to countries other than those covered in (ii) and [illegible]; (v) Total ban on exports; (vi) Exports restricted to certain types of products; (vii) Exports only through collaborator [illegible] distributors; (viii) Restriction on the use of trademarks; (ix) Restriction on the annual value of exports; (x) Restriction [illegible] annual quantum of exports; (xi) Restriction on export prices; (xii) Charging of higher royalty rate for that portion [illegible] which is exported as compared to that on internal sales; (xiii) Prohibition on the use of technology obtained through [illegible] collaboration agreement for exports; (xiv) Any other export restriction.

2) [illegible] Payments: (i) A fixed minimum payment to be made per year; (ii) Payment conditional on achieving a given production [illegible]; (iii) Payments dependent on compulsory exports; (iv) Other conditions.

3) Others: (i) Sources of supply of raw materials and plant and machinery; (ii) Restrictions on production capacity imposed by the collaborator; (iii) Restriction on manufacture of products similar to those produced under the collaboration agreement; (iv) Restriction that internal sales should be routed through distributors specified by the collaborators; (v) Other restrictions.

The survey was critical of the restrictions imposed by foreign firms to safeguard their 'defensive investment', which entailed a virtual banning of exports to potential markets and were not conducive to expansion of production and sales. The survey concluded that "the impact of these disadvantages has, however, to be balanced with the benefits of getting capital from abroad and acquiring the latest technology".[28]

<u>Multiple collaborations</u>

The problem of multiple collaborations for the same product is acute in the metals sector of many developing countries. Even where a know-how licence does not preclude a horizontal transfer and even after the licence has expired, an entrepreneur is generally unwilling to sub-license his know-how to a potential competitor; the latter also feels insecure in being tied completely to the former. This repetitive import of know-how already available in the country creates recurring foreign exchange payments and a multiplicity of designs and specifications. Thus, in India from 1960 to 1964 there have been 14 licences for steel forgings, 10 for ball-bearings, 16 for castings.[29] There have been as many as 40 agreements with a single foreign collaborator.

The difficulties of horizontal transfer have resulted in situations where, say, each tractor manufacturer has a separate collaborator for engines, instead of sharing the know-how from one source with consequent scale and standardization economies. The problem has been tackled more effectively in the case of scooters where Scooters India, a public sector company, will make the engine and power pack for distribution to industrial corporations in various states who will make their own brand of scooter.

Centralized purchase of technology, however, can be applicable mostly in cases of simple repetitive products where changes are not rapid.

28/ Commenting on the RBI survey in its editorial of 25 June 1975, the Economic Times stated: Distortion of the impact of imported technology would seem to be due to ineffective operation of accepted industrial and trade policies and lack of proper perspectives... This calls for not only a revision of existing guidelines, but also improvements in the relevant administrative mechanism to ensure strict adherence to policies formulated.

29/ Subrahmanian, K.K., Import of Capital and Technology, Peoples Publishing House, New Delhi, 1972

Another problem has been the frequent requests for renewals of collaboration agreements. The local party has often been complacent with regard to prompt arrangements for its own R and D to accelerate absorption, adaptation and innovation; the foreign party has created a sense of indispensability by periodic changes in designs. Foreign collaboration is then looked upon "as the perennial source of technology even in simpler products where technological developments have not been fast".[30]

Japan as a borrower and lender of metals know-how

Japan, as the leading technological nation in Asia, has been a major supplier of know-how for metallurgical industries. In the bulk of the cases the know-how agreements have been accompanied by equity participation. Table 3 below indicates the heavy concentration of joint ventures in Asia as compared to other developing countries. It also shows that most of these are in the raw materials and mining fields or for the manufacture of finished products such as galvanized sheet, wire products, pipes and tubes.

Table 3: Number of overseas venture businesses of Japan's steel industry[a]

	Asia	Africa	Latin America	Middle East	Others	Total
Integrated mills	1		1			2
Open hearth/elec. fces	2				1	3
Pipe and tube	7				1	8
Galvanized sheet	13	6	5	1		25
[illegible]	[illegible]					3
[illegible]	[illegible]				2	2
[illegible]	[illegible]				1	3
[illegible]	[illegible]		[illegible]		2	10
[illegible]	[illegible]					[illegible]
[illegible]	[illegible]	1	[illegible]			[illegible]
[illegible]	[illegible]				4	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

At the processing plants, the Japanese partners are involved in supply not only of equipment and technical guidance but the requirements of materials and intermediates as well. The preponderance of rolling and fabricating operations among the joint ventures, admits a Japanese study,31/ 'may be the result of the Japanese mills efforts to secure export outlets for their products'.

Regarding the type of technology accompanying direct investments, an ECOCEN report states:32/

> "The general conclusion which emerges is that product and process-embodied technology associated with Japanese overseas investment has not been very significant, except possibly for artificial fibres... Metal-based products, on the other hand, have involved mainly general machinery (available from many sources) which have little technological content. Even the complex product types (e.g. car manufacture, radio and television manufacture) have involved only assembly type technology..."

When it has now come to the <u>import of technology</u>, the Japanese metals industry has done this on a grand scale, and this has contributed significantly to its pre-eminence. In the steel industry, approximately 1,000 to 1,700 foreign techniques have been introduced every year since 1963; the annual expenditure on this was $433 million in 1970 alone.33/ To complement and reinforce this, an average of 1,000 engineers are inducted into the industry each year and the R and D effort on indigenous technology has been very substantial.

Japan spends two-and-a-half times as much as India on import of technology. But the point to note is that for every dollar so spent, Japan incurrs $7 on its own R and D while India spends only $1.40.

31/ Japan's Iron and Steel Industry, 1974

32/ Allen T.W., Direct Investment of Japanese Enterprises in South-east Asia, ECOCEN, Bangkok, February 1974

33/ Tabata S., Changing Features of the [illegible] Iron and Steel Industry, Third Inter-regional Symposium, [illegible], [illegible], ID/WG.146/[illegible]

IV. LICENSING FOR ALLOY AND SPECIAL STEELS

The making and shaping of alloy steels calls for a relatively high level of techniques and skills. As many developing countries start with arc furnaces for producing ordinary steels, the move towards using such furnaces for special steels is logical. For the simpler low-alloy and carbon tool steels, local experience supplemented perhaps by engaging an expatriate could be adequate. But if a wider range of steels to correct quality specifications is to be produced, it is generally quicker and more economical to acquire such know-how through a license with a reputed alloy steel producer.

This would cover not only processing techniques but also production planning, maintenance, product application and after-sales service. The technology can be transmitted through (i) comprehensive documentation on instructions and standards to be followed for all processing stages, starting from raw materials to finished products; (ii) training of key personnel at the collaborator's works, so that they are available in time for commissioning the plant units. To be effective such training has to be carefully planned and supervised, with trainees given theoretical and practical instruction as well as some opportunity to handle the equipment on the shop floor; and (iii) deputation of specialists for short durations to [illegible] commence [illegible] production operations at the licensee's plant.

[illegible]

Case study

When the first major public sector alloy steel plant was to be set up in India in the early 1960s, the Government had originally intended to entrust the project studies, engineering and know-how contract to a consortium consisting of a foreign consultant and an alloy steel producer. But the Indian consulting firm with which the author was associated pointed out that the project services should be "unpackaged" because the project planning capabilities and part of the know-how were already available within the country while only supplementary production know-how was required from abroad. This view prevailed and the plant (capacity of 100,000 tons alloy steels per year, involving an investment of US$70 million) was engineered by the Indian consultants.31/

Proposals for only the balance know-how were invited from five international firms. The offers ranged from about US$2.5 million to US$[illegible] million for identical terms of reference! The contract was concluded in 1961 for a fee of $5.4 million and a royalty of $7 per ton for a period of six years of commercial production, subject to maximum of US$1.6 million. Contract duration was 12 years.

The know-how contract covered operating manuals for a comprehensive range of constructional, stainless, tool and die steels; training of 100 technical and managerial personnel at the collaborators works for periods of 6 to 12 months; and 540 man-months of specialist services deputed to the licensee's work to advise in matters of production.

The know-how to be transferred included 'all inventions, patents, applications for patents and secret knowledge and know-how' for exclusive use during the term of the agreement and non-exclusive use thereafter. The Indian plant was indemnified against liability due to infringement of patents not held by the licensor. The agreement also provided for use of the licensor's brand name on alloy steels for sale in India.

Close co-operation between the client, foreign know-how [illegible] and local consultant resulted in an effective transfer of this [illegible] technology. As a major [illegible] indigenous capability for building [illegible] complex projects in future was [illegible].

31/ M.N. Dastur and Company, [illegible] Engineering [illegible]
- The Indian [illegible]
Steel Industry, [illegible] May 1973

Table 4 summarises the principal features, contract period, scope of services, remuneration and mode of payment of five actual licensing arrangements for alloy and special steel mills in India. Durations of agreements are 5 to 10 years. Payments generally consist of a fixed fee plus royalty of 0.8 per cent to 3 per cent of finished saleable steel value, subject to a maximum amount. While these cases give broad indications of the types of contracts possible in this sector, each project has obviously to plan and negotiate arrangements to meet its specific requirements.

A check-list of the typical areas, from raw materials through production of finished alloy steels, which should be covered by written instructions and standards in licensing agreements of this type are given below:

Raw materials - Standards covering analyses, size and other specifications
Flux nomenclature
Scrap standards covering grades, classification, segregation
Quality control

Production - Melting standards (grade-wise) including detailed description of the steelmaking methods, quality controls, special instructions to match the grade-wise requirements, melting sequences etc.
Heat treatment standards (grade-wise) including the type and duration of treatments, temperatures, special [illegible]
[illegible] standards for [illegible] grades [illegible] including [illegible] practices,
[illegible]

	Rolling standards to include roll pass schedules and rolling speeds for each size of product and rolling sequence, controlled cooling practices
Conditioning	- Methods of surface preparation grade-wise, standards for ultrasonic, magnaflux and visual inspection
Bar mill	- Heating standards indicating grade-wise the rolling temperatures, soaking time and temperatures, furnace atmosphere, rate of heating Rolling standards including roll pass schedules and rolling speeds for each size, rolling sequence, controlled cooling practice for bars, coils etc.
<u>Heat treatment and finishing</u>	- Annealing/normalising cycles, grade-wise, including the heating cycle, cooling cycle, atmosphere control requirements etc. Heat treatment cycles indicating hardening temperatures, heating rates, times, quenching media, tempering temperatures and times, hardness to be achieved etc. Methods to be adopted for finishing, namely shot/sand blasting, pickling, inspection standards for finished products Standards for cold drawing indicating lubricants and percentage of reduction; for centreless grinding, indicating the number of passes, metal removal etc.
<u>Plant general processing standards</u>	- Grade-wise process flow sheets. These should also indicate salient features such as scrap classification, testing requirements, special customer requirements etc.
<u>Inspection and testing standards</u>	- Covering the different grades, the test requirements, samples collection and preparation, special tests if any, inspection procedures, standards of inspection etc.
<u>Production planning and order services</u>	- Manuals covering standard procedures, yields, schedules for melting and rolling, order scheduling, follow-up and records procedures etc.
<u>Customer service</u>	- Indicating product application, investigation and complete follow-up procedures, history cards etc.
<u>Maintenance</u>	- Preparation of maintenance manuals Organising preventive maintenance scheduling, coordinate and evaluate preventive maintenance instructions provided by equipment suppliers

TABLE 4 : SUMMARY OF KNOW-HOW LICENSING CASES IN ALLOY AND SPECIAL STEELS [1]

[illegible] for the production of carbon and alloy constructional steels, carbon and alloy [illegible] stainless and heat resistant steels. Products include billets, bars and rods, forged [illegible] plant capacity is 100,000 tons of ingot steel per annum with provision for expansion to [illegible]

[illegible] shop: Electric arc furnaces, induction furnaces, vacuum degassing unit. [illegible] reheating and annealing furnaces. Blooming and Billet Mill Electric soaking pits [illegible] blooming mill billet mill. Conditioning: Facilities for grinding blooms and slabs, [illegible] cutting etc. Bar mill: 15 stand semi-continuous bar and rod mill. Heat Treatment [illegible], hardening and tempering furnaces, straighteners for bars and coils, cutting [illegible] facilities. Sheet mills: 3-high plate mill, 2-stand two high hot mills, Sendzimir [illegible] pickling and finishing facilities.

[illegible] agreement concluded in late 1961. Duration of agreement was 12 years.

[illegible] documentation covering all stages of processing for the different grades of steel. [illegible] personnel trained at collaborators' steel works. Specialists were deputed to the company's [illegible] 40 man-years. Setting up of an effective 'product application and service organisation'.

[illegible] per ton subject to a maximum of US$1.6 million.

[illegible] signing 15%; within 2 years 25%; six equal yearly instalments payable after 4 years,

[illegible] steels plant for the production of different grades of carbon and alloy constructional steels [illegible] The capacity of the plant is about 18,000 tons of products per year.

[illegible] shop: Electric arc furnace.- Forge shop: Forge press and hammers.- Rolling mills: [illegible] in cross-country fashion.- Heat Treatment : Annealing furnaces, hardening furnace,

[illegible] agreement concluded in late 1963. - Duration of agreement was 10 years.

[illegible] Complete documentation covering all stages of processing for the different grades of steel, 36 [illegible] personnel trained at Collaborator's steel works. Specialists were deputed to the plant as [illegible]

[illegible] 000

[illegible] of sales value for first two years and at 0,8% in subsequent years- subject to a maximum of [illegible] 100,000

[illegible] signing 10%; 3 equal yearly instalments 30%; 10 equal instalments after start of production,

---

[illegible] International GmbH. Düsseldorf

[illegible] maintenance of the specialists deputed by the collaborator to the plant and the expenses related to the [illegible] at the collaborator's works were not included in above payment. These had to be borne by company.

Table 4 : (Continuation)

Case 3 : An alloy and special steels plant for the production of carbon and alloy constructional steels, low and high alloy steels, and stainless steels in the form of bars and rods. The designed capacity is about 77,000 tons of finished products.

Principal facilities- Steelmelt shop: Electric arc furnaces. - Rolling mills: Blooming mill, heavy section mill, combined bar and rod mill - Conditioning: Ingot milling lathe, automatic grinders, swing grinders- Heat treatment facilities: Annealing furnaces, hardening and tempering furnaces.

Period of Contract- Know-how agreement concluded in late 1963. Duration of contract was 10 years.

Scope of Services- Advice on production and processing - Training of mutually agreed upon number of personnel at collaborators steel works- Specialists were deputed to the plant as and when required for efficient transfer of know-how.

Payments- Fees: 2,500,000
Royalty: At 3% of finished salable steel value subject to a maximum of US$ 196,000

Mode of payments: Contract signing 10%; within one year of agreement [illegible]; within [illegible] months of agreement [illegible]; within 2 years of agreement 15%; within 30 months of agreement 15%; within [illegible] years of agreement 15%.

Case 4 : A special steel plant for production of 6,000 tons alloy constructional steels, carbon and alloy [illegible] steels, [illegible] die steel, high speed tool steels, - products include forgings, rolled bars and billets.

Principal facilities- Steelmelt shop; electric arc furnaces, electro-slag remelting unit (the first in [illegible] country) - Forge shop; [illegible], Rolling mills: Open train bar mill and heat treatment and finishing facilities.

Period of contract- Know-how agreement concluded in mid-1971- Duration of agreement was 5 years.

Scope of services- Preparation of detailed specification for ... unit - Advice on problems related to manufacturing procedures- Training of mutually agreed upon number at collaborators' steel works.

Payments- Fees: At 3% of net ex-works selling price

Mode of payments- Contract signing US$25,000; guaranteed minimum royalty in 1st year US$25,000; guaranteed minimum royalty in 2nd year US$15,000; guaranteed minimum royalty in 3rd year US$15,000.

Case 5 : A proposed alloy and special steel plant for production of flat products. The first phase of the project envisages production of 30,000 tons of cold rolled stainless steel sheets and strips from imported hot band.

Principal facilities- Cold rolling mill: one Sendzimir mill - one Skin-pass mill - two continuous annealing and pickling lines - strip grinding line- coil build-up, shearing, slitting line, publishing and other finishing facilities.

[illegible]- Contract yet to be finalised. Duration of agreement is expected to be about 10 years.

[illegible]- Discussion of technical aspects for efficient production, complete transfer of information for [illegible] to cold rolled stainless products- Training of about 60 technical and managerial personnel at [illegible] works- Specialists to be deputed to the company's plant as and when required.-Setting up of an "[illegible] and Service Organisation".

V. GOVERNMENTAL INTERVENTION IN TECHNOLOGY ACQUISITION

If technology is the production factor par excellence and metals constitute a key industrial sector in many developing countries, then dynamic government policies and instruments are essential to intensify technology acquisition for metallurgical development.

Monitoring of imported know-how

Take first the importation of technology. It has been argued that "the marginal cost of using or selling an already developed technology is zero for the owner of that technology".35/ But due to the inadequacy of the present technology market system the poor countries of Asia alone now pay US$2,000 million every year for their imports of know-how. And often they do not get all the know-how they pay for, and pay many times more indirectly to be able to utilize what they paid for in the first place. Such a situation cannot long continue.

In the 60s most governments of developing countries exercised practically no control on know-how transactions while a few monitored the direct foreign currency payments, that is, 'only the visible top of the technological iceberg'. In Latin America, starting in 1971 Argentina established a national Register of Licence Contracts and Transfer of Technology, which has been strengthened in [illegible]. Also in 1971 the Andean countries set up a [illegible] (Decision No. 24 of the Cartagena Agreement) [illegible] and Brazil reorganized the [illegible] with [illegible] for the [illegible]. In January 1973, [illegible] in [illegible] technology [illegible]

In Asia, India and South Korea have explicit policies governing technology acquisition, while Indonesia, Malaysia and Philippines are evolving from a tax/investment orientation to some forms of institutional arrangements. In Thailand (and Singapore) the "practical logic may be that it is more important to get industries established than worry about the extra cost to the economy that the absence of such arrangements may entail".36/

Developing countries are coming to the consensus that technology regulation is unavoidable, even necessary and beneficial, both for short-term objectives of getting the right technology at the right price as well as the long-term need for augmenting their skills. Whether the evaluating and approving is best done by a single multi-displinary agency as in Mexico or by a nucleus co-ordinating a multiplicity of agencies as in India, by special law or by administrative fiat, depends on individual conditions and needs. Essential, however, are a built-in flexibility and a mandate to stimulate the inflow of technology while regulating it.

The careful formulation of an internationally-enforceable code on technology transfer could assist significantly in bringing order into what is now an unequal market situation. The comprehensive UNCTAD studies on this now provide the conceptual framework and an evolving consensus for such a code.37/

National technological information centres are also essential. An international system on technology licensing could then connect these local institutions into a network and by exchanging contract information and personnel, help strengthen national negotiating/selecting capabilities.38/

36/ K. Venkatraman, National Approaches on the Acquisition and Adaptation of Technology through Licensing in Asia, Regional Seminar on Knowhow about Licensing Arrangements, Manila, June 1974, UNIDO ID/WG. 178/1

37/ Recent UNCTAD studies include Major issues arising from the transfer of technology to developing countries (TD/B/AC.11/10/Rev.1), the possibility and feasibility of an international code of conduct in the field of transfer of technology (TD/B/AC.11/22) and Preparation of a draft outline of an international code of conduct on transfer of technology (TD/B/C.6/AC.1/2/Supp.1).

38/ Report of Inter-regional Consultations on Formulation and Application of the Mexican law on Licensing and Patents, UNIDO ID/WG. 194/6, [illegible]

The concept of "appropriate technology" has been tested at the micro-level in Asia and has gained acceptance. There is, however, a need to link policy objectives and policy instruments with micro-level technology choices. On this basis decision-makers can design the inducements and actions necessary to increase employment and develop natural resources through social costing of production factors, alternate product and product-quality mixes, etc.

Strengthening national R, D and E capabilities

Concurrently, governmental interventions are essential in providing the policy framework and incentives for developing indigenous metallurgical research, commercialization and engineering capabilities.[39] Undue dependence on foreign investment and on tied foreign aid - and the technology that comes with these - could be disincentives to the growth of basic local skills. As noted earlier, even the rational import of technology and its effective use needs competence in identifying requirements, selection and adaptation, particularly as extractive processes are specific to raw materials available locally and metal-working techniques can be modified to suit local production factors.

In most countries lack of technical skills is not the real constraint in developing a self-reliant metals industry - it is the lack of government policies and sound technical leadership.[40] Given these - and the opportunity to do responsible development work, with selected foreign technology in a supportive role - the indigenous technology movement can quickly gather momentum. As figure 3 indicates, the flow of innovation, starting as a trickle and augmented in stages by the feed-back of data and by additional industrial experience, can become a flood. The accompanying sophistication of metallurgical activities is also shown in the figure.

[illegible]

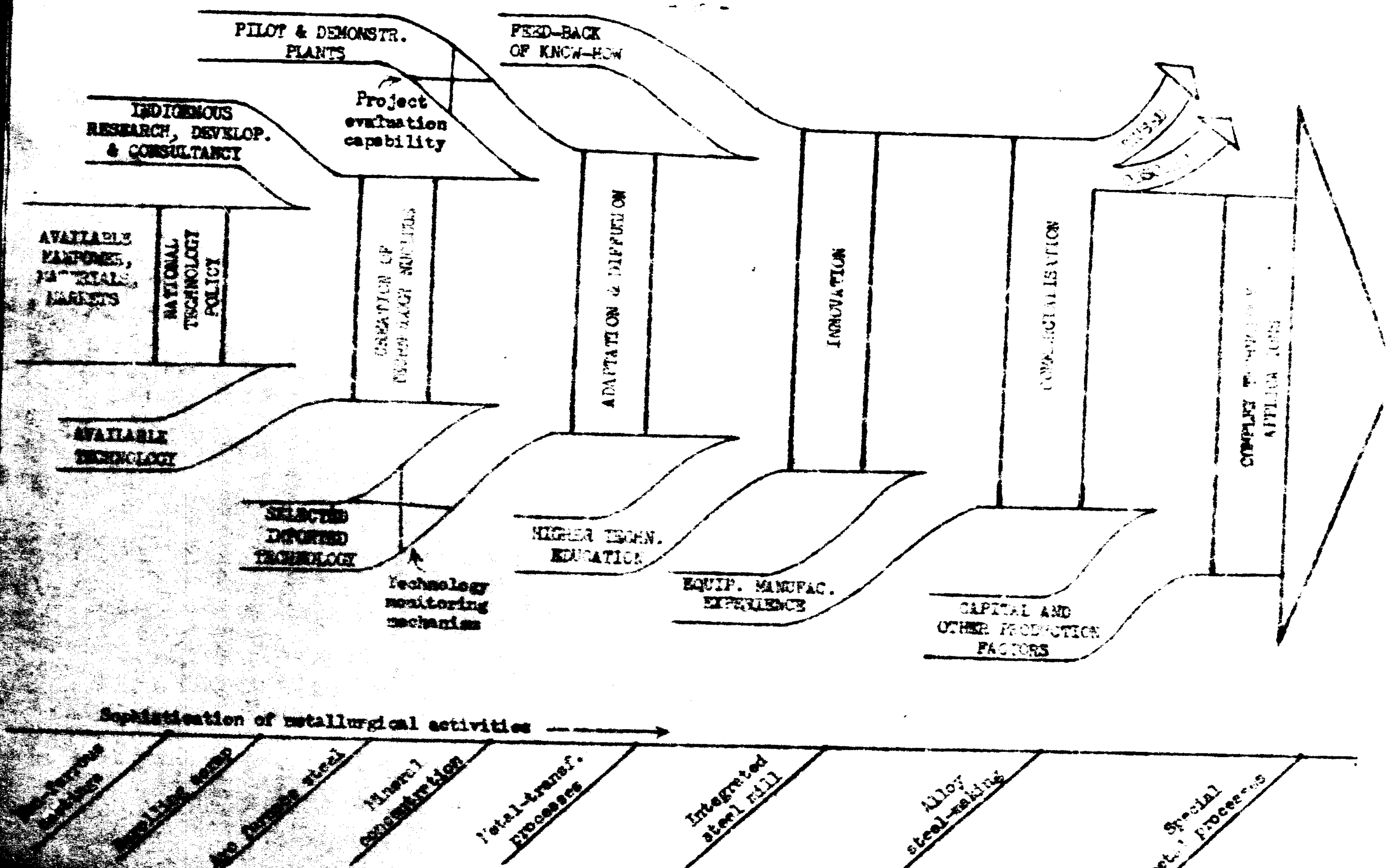


Figure 1: ACCUMULATION OF KNOW-HOW

services are utilised, this experience stays within the country. Further, by inter-actions between consultant and equipment manufacturers, there is a flow of design data, specifications and test reports between them which help in developing local machine-building capacity.

The consultant can develop effective liaison with universities and laboratories, so that technical education and research work both become more relevant. He can also be a valuable link with government planning agencies, thus bringing a sharper technical focus to the tasks of project evaluation, resource allocation and implementation. By his life-long familiarity with local conditions, the consultant's designs and process solutions are more likely to be in harmony with the economic and social environment.

Consultancy work is information-intensive and once a vortex of information activity is created, more information rushes in. Process promoters, equipment manufacturers and others are then forced to submit more data. Once the flow has started, the effect is self-reinforcing. A little technology attracts a lot.

In the long-term, the development of a strong consultancy tradition can play a significant role in rapid industrialisation. Recourse to foreign consultants may still be necessary due to gaps in know-how or discontinuous activity in plant design work. But in many developing countries it is now possible - and preferable - to give responsible tasks to local organisations, securing only supplementary expertise from outside sources.

__Conclusion__

Given the problems of growing unemployment, dispersed materials deposits and markets, the expansion of mineral and metal-based industries in developing countries calls for the application of upgraded traditional processes [illegible] together with adapted modern technologies [illegible]. The [illegible] of both these requires a base of local technical consultancy.

To increase investment and technology significantly in metallurgical industries in the coming decade, greater attention will also have to be paid to creating the high-level technical and administrative skills for the management of technology transfer. The inculcation of values and attitudes may be as important in the development of such skills as the imparting of new knowledge. A variety of non-formal learning experiences will be needed.

Strengthened national capabilities in technology management together with effective technical co-operation between the developing nations themselves can be expected to increase the inflow of technology for development.

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