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THE ROLE AND EVALUATION OF INTERNATIONAL TECHNICAL CONSULTANTS FOR THE ESTABLISHMENT OF IRON AND STEEL INDUSTRIES IN DEVELOPING COUNTRIES

prepared by

the Secretariat of UNIDO

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SUMMARY

The role and evaluation of international technical consultants have been outlined in this paper vis-à-vis establishment of the iron and steel industry, particularly for developing countries. It is acknowledged that there are some distinguished international technical consultants, who have provided outstanding services to the iron and steel industry of the developing countries. However, these high standards of technical consultancy services and competence are not uniformly maintained. Details are furnished of the scope of work of the technical consultants relevant to the establishment and growth of the iron and steel industry; some cases of shortcomings and deficiencies therein have been outlined, referring inter alia to the preparation of Detailed Project Reports, project implementation, guarantee operational trials and norms. The role and value of international technical consultancy services in the diverse fields of the iron and industry for the developing countries have been highlighted.

I. INTRODUCTION

Industrialization of developing countries and regions is considered in some quarters to comprise principally (exceptions apart) (a) massive inflow and transfer of technology from developed countries and (b) equally massive supply of imported heavy plant equipment and machinery. Normally such import of technology and technical know-how and the import of heavy plant and equipment are channelled to a developing country through the engagement of international technical consultants. The flow of foreign capital quite often supplements the import of technology and the plant equipment. The cost to a developing country of the import of technology, plant and equipment, and the capital can indeed be very heavy for a developing country and its economy. The supply of capital funds on loan and bilateral aid is not so simple as it looks prima-facie. If a developing country needs a lot of capital, it has to pay a lot for it and the poorer a developing country is, the more it may have to pay. In heavy industry, such as the iron and steel industry, capital finance is a commodity which has to be imported and paid for on an identical basis as the import of technology and the plant and equipment. The steel industry, being heavily capital-intensive, entails heavy servicing of loans and capital aids.

An estimate of the direct foreign exchange costs of the transfer of technology to the developing countries, covering only payments of patents, licensing, know-how, trademark and consultancy services, indicates that these would have reached 1,500 million US dollars by the end of the Sixties 1/. If the targets of the Second Development Decade are to be attained, these payments could well increase six times by the end of the Seventies to 9,000 million dollars. The following table illustrates the above aspects:

1/ Far East and Development - March 1973, p. 108 - 109

Payments by some of the Asian developing countries for the transfer of technology (in million US dollars)

Country	Most recent year available	Patents, licenses, know-how, trademark	Management and other technical services	Total
India	1969	6.4	43.2	49.6
Indonesia	1968	25.0	n.a.	-
Iran	1970	1.7	1.6	3.3
South Korea	1970	2.1	n.a.	-
Pakistan	1965 - 70 (annual average)	2.1	100.0	102.1
Sri Lanka	1970	0.1	9.2	9.3

The industrial requirements of developing countries generally include the acquisition of appropriate technology, often on a package basis, and of heavy plant and equipment, very often on a turn-key basis. The role which international technical consultants play in such massive acquisitions is indeed supreme.

There are indeed some distinguished international technical consultants which have done excellent and outstanding services to the developing countries and dedicated themselves to such tasks, whilst there may be others solely motivated to secure business and make money at all costs completely out of proportions to services rendered and, of course, there are multiple and ingenious ways of doing so and the developing countries present a fertile field therefor.

Technical Consultancy Services normally comprise:

(a) Pre-investment feasibility report, ranging from appraisal of raw materials on the one hand to market study and projections on the other.

(b) Feasibility project report outlining the techno-economic structure of the project and how it will contribute to the Gross National Product and could therefore obtain maximum use of the indigenous resources of raw materials and manpower.

(c) Detailed project reports, including suitable choice of site location, plant layout and services, general specifications of the plant, equipment and machinery, materials balance and flow-sheets, choice of technological processes and the applications of latest technical "know-how" and innovations and, last but not least, the overall production economics based on the net operational costs and total production costs at successive stages of the semi-finished and finished end products taking into account the capital charges and overheads. The "Detailed Project Report" should comprehensively deal with the sources and means of possible capital financing and assess cash flow analyses and the profitability or otherwise of the integrated project, before and after taxes.

The "Detailed Project Report" may also include the study of the turn-key and package deal contracts in relation to split-up contracts based on maximum utilization of local fabrication manufacturing facilities. Relevant studies on demarcation of responsibilities for the erection, assembly, and commissioning of the plant units should be included in the "Detailed Project Report". The inclusion of suitable and effective guarantees for the plant's attainment of its in-built capacity in relation to its "rated" production capacity will need to be ensured. Plant management, provision of technical manpower and operational personnel including expatriate personnel and expenses, training programme for skilled operators and supervisors will need to be defined in the "Detailed Project Report" on a long-term and phased basis.

The country's steel market requirements and their future projection will need to be outlined in relation to the plant's product-mix, which it will feed into the home market or for possible exports to regional countries.

The infra-structure facilities and services for the future expansion of the plant and the means to achieve them may be outlined in the "Detailed Project Report".

The applications of research and development work, including quality control, standardization of the end-products and the analytical laboratory facilities, should find a place in the "Detailed Project Report". These multiple aspects of the technical know-how and its acquisition on the one hand and detailed project engineering on the other have received little attention (with a few exceptions), so far in the developing countries. The developed countries, whilst keen to supply the capital funds as equity partnership or loan/long-term credit and equally keen to secure business and orders for the supply of the plant and equipment are very often just not interested at all (with exceptions apart) to set up the requisite "Technical Consultancy Services" in a developing country itself or to assist the developing nations to establish such "Technical Consultancy Services" themselves, with the result that to-day a serious "technological gap" in the creative and applied technology persists in the steel industry of the developing countries.

Developing countries such as Brazil, India, etc. have inter alia endeavoured to build up their own technical consultancy services, both in the public and private sectors and with valuable results. In the case of India, the recommendations made by its Planning Commission [1] with the objectives of speeding attainment of the largest possible measure of self-reliance in technical consultancy services for the industry including the iron and steel industry cover: (1) routing of import of process know-how and equipment design through consulting/process engineers so as to avoid repetitive import of the same technical know-how; (2) allowing the import of new and improved processes and technologies for the manufacture of the same product only when there is demonstrable advantage in doing so; (3) allowing import of know-how and process designs as far as possible only on non-exclusive basis; (4) avoiding the import of package deals and turn-key jobs; (5) encouraging the establishment of proper liaison between research laboratories, equipment and product manufacturers, consultancy and

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1/ Journal of Scientific and Industrial Research, Vol. 29, December 1970, No. 521/530

process design organizations as a means towards hastening the commercial utilization of the results of indigenous research, design, and development work; (6) avoiding expenditure of foreign exchange on feasibility studies; and (7) ensuring that the main work of compilation of data and designing of the plant and equipment is done within the country, if necessary by inducting assistance from foreign experts.

II. ROLE OF INTERNATIONAL TECHNICAL CONSULTANTS IN THE ESTABLISHMENT OF THE IRON AND STEEL INDUSTRY IN DEVELOPING COUNTRIES

The subject of the role and the evaluation of the services of international technical consultants for the establishment of steel industry is complex and controversial, even in an advanced country where the roles of the technical consultants, the client, and the financing agencies respectively are fairly well understood in their joint endeavours to promote the success of the steel enterprise.

Developing countries on the whole lack their own technical consultancy services of the status and calibre needed for the highly capital-intensive and modern integrated steel industry. As such, the developing countries endeavouring to attain self-sufficiency in iron and steel production have to rely on the services of international technical consultants, who are as much foreign to the developing countries as the foreign capital which seeks investment on favourable terms in various developing countries. Evaluation of the services of international technical consultants for the steel industry in developing countries is still more complex depending inter alia upon the basis and nature of such an evaluation. This brings in its train certain unavoidable factors in developing countries, which are plagued with the shortage of capital funds, lack of technical expertise and trained manpower both at the operational and management levels. The choice before the developing countries is not easy. Socio-political conditions in developing countries are excluded from the scope of the present study, although they do provide either some constraints or promotional factors in the background of industrial development.

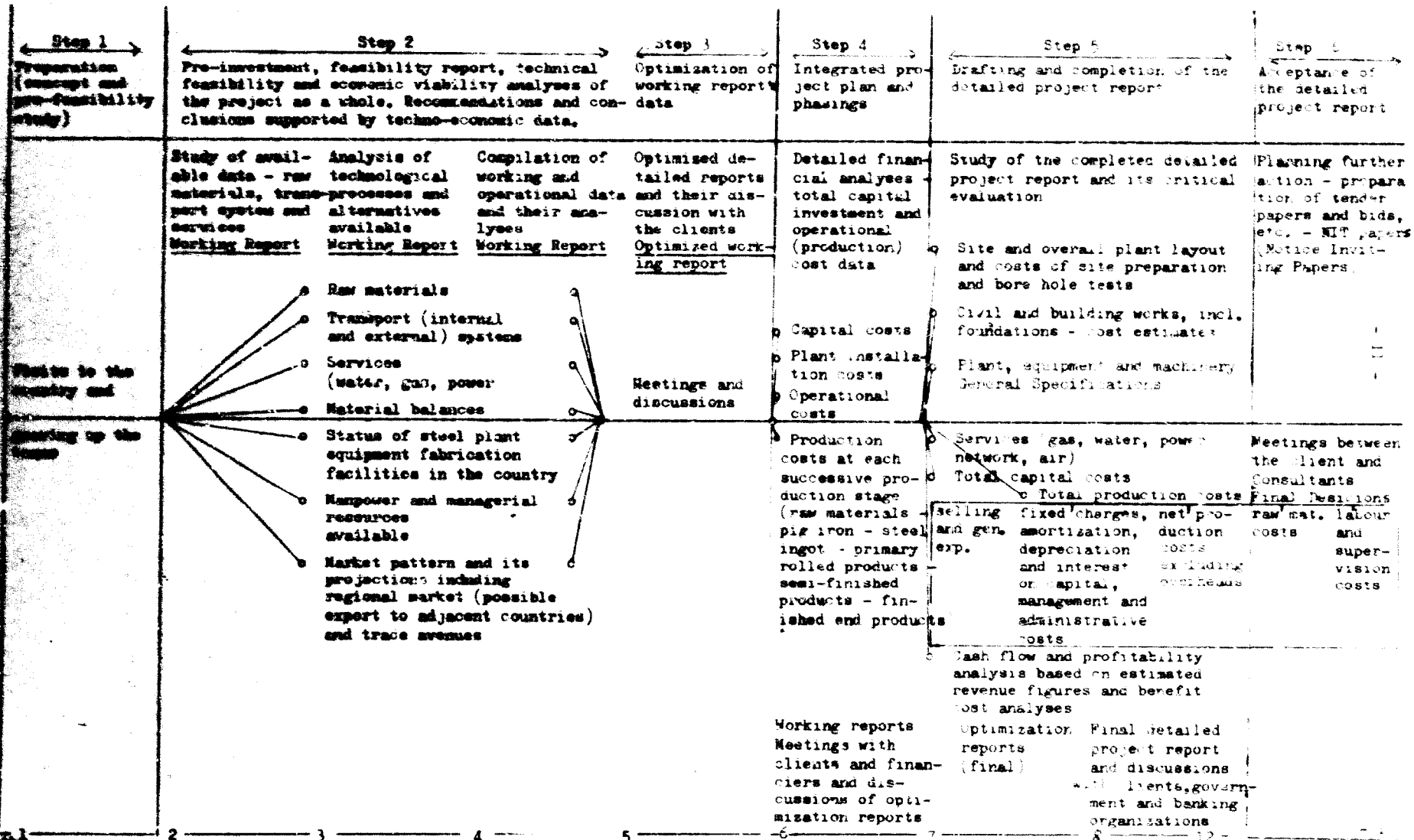
The three main parties concerned with the establishment of the heavy steel industry in a developing country are (a) the client, viz. the industrialist in the public or private sector, (b) the technical consultants, and (c) the financing institutions (state or private banking organisations) including foreign capital, bilateral loans and/or barter trade financing, etc.

Technical consultancy services may be regarded as the second phase of the four consecutive phases which have to be passed through to complete the integrated steel project. First, one has the general concept; the second covers the studies and reports on the technical feasibility and economic viability of the project on which is to be based the steel plan; third is the implementation of the steel plant, with detailed engineering design and construction work; the fourth phase comprises the starting-up operations, commissioning of the project, and working up the plant to full performance.

The second phase is sub-divided into five steps as shown in the attached fan diagram. This work is undertaken, inter alia, by technical consultancy services appointed by the client.

Before any evaluation of the work of technical consultants for the steel industry in developing countries can be done, it is necessary to examine their modus-operandi in some detail. When more than one technical consultant is appointed, as shown later in this review, it is equally necessary to study their working for the client and the modus-vivendi arrived at between the parties concerned.

The appointment of a separate consultant firm to assist in the operations and plant management is common in some of the developing countries. This consultant firm functions almost as the management both during the plant's construction phases and additionally for the first few years of the integrated operations of the entire iron and steel works. During these periods, the actual owners of the steel plant (public or private sector) act only as the senior supervisory body. This consultant firm has to ensure on behalf of the owners of the steel plant the implementation of the "guarantee clauses" contained in the "Agreements" made with the suppliers of the major plant equipment, machinery, and ancillaries in terms of their guaranteed operational performance. On the other hand, this work can also be undertaken by the same technical consultant who had prepared the original detailed project report including detailed engineering of the main plant, ancillaries, and services. Such multiple



FAN DRAWING: Technical Consultancy Chart from the Start of the project to the acceptance of the Detailed Project report (excluding the supply of plant and equipment and their installation, commissioning and operations).

responsibilities and modus operandi of the main parties (excluding the actual owners of the plant, public or private sector) create difficult situations in the case of developing countries. If the two consultant firms do not discharge their obligations conscientiously and in the best interests of the clients, situations can arise whereby considerable loss of financial resources is inevitable. Such unhappy situations and actual cases have arisen in some of the developing countries in establishing their iron and steel industry.

In the case of a large and integrated steel plant, it is not common to place the orders for the plant equipment and ancillaries with a single firm but with a consortium of firms. This consortium can be composed of leading firms from a single country or from different countries. The consortium can also, if required, arrange long-term credit facilities on a Government-to-Government basis and/or through banking agencies and investment centres.

Apart from the normal guarantees for the quality of the plant equipment and machinery, the obligations of the consortium may terminate on satisfactory results of the performance tests. The performance tests are normally confined to the attainment of the design output figures over a specific period of time and carried out under stipulated conditions; all these variables have to be negotiated and agreed upon well in advance by the concerned parties. One has only to think about the multiplicity of various loop-holes in these multiple agreements to realise how the technical consultants do operate. To an inexperienced owner (public or private sector) in a developing country, these present a formidable array of alignments which should be fully protected in the best interests of the clients of the developing countries.

If a "turn-key" contract for the supply, erection, and commissioning of the entire steel plant is entered into by a developing country, although its immediate effects may appear advantageous to a developing country; in the long run, however, the latter can run into unforeseen difficulties on many counts including financial liabilities. There are subtle points that

are not readily discernible, even though "turn-key" steel-plant contracts appear attractive to a developing country and seem to simplify the responsibilities all around. However, the actual experiences of "turn-key" contracts in some developing countries, have not been happy in terms of capital costs and the legalities over the interpretations of various contract and agreement clauses have dragged over a protracted period.

These then are some of the inescapable difficulties and onerous responsibilities that a developing country must shoulder on the road to economic development in which the basic iron and steel industry plays an undisputed and important role.

III. SCOPE AND OBJECTIVES OF TECHNICAL CONSULTANCY SERVICES IN THE ESTABLISHMENT OF AN IRON AND STEEL INDUSTRY IN DEVELOPING COUNTRIES

A. Feasibility Study

(a) The first and the most important step to take when planning an iron and steel plant is the preparation of a feasibility study. The importance of feasibility studies in developing countries where conditions differ considerably from those met with in developed countries cannot be underestimated. There are, however, cases where the developing countries are additionally faced with lack of certain basic raw materials such as high-grade metallurgical coking coal, high-quality iron ores, etc.

(b) The object of preparing a feasibility study is related to the fundamental clarification of certain basic techno-economic factors which govern the success or the failure of the entire project. These cover mainly the following parameters:

i) Domestic market requirement and probable export possibilities. Availability of basic and auxiliary raw materials in the country in the background of currently increasing trends to import high-grade iron ore where the local iron-ore deposits are not sufficient and/or are of poor quality.

ii) Capacity of the plant and the nature of multiple product-mix the plant will be designed to produce.

(c) Choice of technological processes including pre-reduction, electric smelting or blast-furnace smelting of iron ores, the size and nature of the rolling mills and auxiliary equipment for metal transformation (rolling, forging, extrusion), continuous casting. Approximations of the capital costs including the foreign exchange component. Approximations of the production cost for each of the constituent product-mix and assessment of profitability of the integrated project.

Resumé of the recommendations and summary of the project and comments on whether or not the project should be implemented.

B. Optimization Studies and Final Selection and Elaboration of the Selected Scheme of Operations, including Selection of the Site, bearing in mind the soil conditions (these will require soil tests and determination of the load-bearing capacity of the soil).

The location of the plant will be governed inter alia by the status of the transport facilities (for each ton of steel produced, over four tons of the raw materials must be transported to the plant site). The selected scheme of operations including the choice of technological processes will bear in mind the capacity in the country for the manufacture of steel-plant equipment and machinery in order to reduce the foreign exchange component to the minimum possible figure. This optimisation study will lead in its ultimate analysis to the preparation of the detailed project report.

C. Detailed Project Reports

will contain the overall plant layout including that of the individual constituent units, the provision of services (gas, water, power, compressed air, etc.); full specifications of the plant equipment and machinery, material balances and the plant flow-sheets; the capital investment costs, the working capital and assess the overall profitability of the integrated project. The detailed project report may refer, if required, to the possibilities of a turn-key package deal related specifically to a particular country and scope of split-up contracts based on maximum utilization of the manufacturing capacity for steel plant equipment in the country.

D. One of the main lacunae in the detailed project report prepared for the developing countries by technical consultants relates in many cases to the omission of guarantee clauses and guarantees in respect of original capital cost estimates and production cost projections, the performance and capacity of the integrated plant to attain its rated output based on the norms of raw materials already worked out in the detailed project report. The project report will also outline the manpower requirements including the labour force, supervisory staff, business management and administrative personnel, etc. The detailed project report will also comprehensively outline the training programme in the above categories of the manpower requirements for the integrated steel plant. Details will

also be furnished of the expatriate expert staff, including the expenses to be repatriated mostly in foreign exchange.

E. Detailed Project Engineering

The detailed project engineering will provide complete drawings including working drawings, preparation of tender papers based on the specifications contained in the detailed project report, scrutiny and selection of the tenders and appropriate advice to the investors or the Government, as the case may be, before entering into agreement with the selected firm. Considerable caution and alertness are required to ensure that the consulting firm is not involved directly or indirectly with the firms who will be assigned the contracts for the supply of plant equipment and auxiliaries, including infra-structure equipment. In the detailed project report and detailed project engineering, the critical path analysis and modern network methodology would be followed.

F. Execution of the Project in Collaboration with the Technical Consultants

The actual implementation of the project will require the in-plant training of the plant workers, operational supervisory, and management staff in order to fix the operational data to establish actual production norms and yield figures at each successive step. It is possible that the consultants who will undertake these duties would be different from those who had prepared the detailed project report and/or the detailed project engineering. There is considerable merit in having a separate consultant firm during the commissioning, running in, and operation of the integrated plant, in order that this consultant can adjudge the technical contents and financial projections contained in the detailed project report prepared by the original technical consultants. Thus, there are three different stages involved in the design of an integrated steel plant. The first stage is the feasibility report and the preparation of the detailed project report. The second stage covers the preparation of detailed engineering and working drawings for the integrated steel plant and its constituent units (blast furnaces, steelmaking shop, rolling mills, finishing departments, etc.). The third stage is related to the preparation of detailed designs of the plant equipment and relevant drawings and blue prints, such as for the blast furnaces, LD oxygen steelmaking units,

etc. and their fabrication, since none of them can be bought "off the shelf" as if it were. In elaborating the three stages, it is pointed out during the first stage, technical feasibility and economic viability of the project are analysed covering market surveys, economic data, the product-mix along with an assessment of the most suitable location of the integrated steel plant. During this stage, the detailed project report is prepared, outlining the merits and demerits of various technological processes and selection of the most optimum, the plant lay-out, transport network, the estimates of the total project investment costs, assessment of operational and production costs, cash flow and profitability analyses, etc.

The second stage involves the detailed project engineering of each of the plant units, such as the coke ovens, by-product plant, blast furnaces, steelmaking shop, continuous casting, rolling mills (hot and cold mills), processing and finishing lines and of the auxiliary units and services. It is at this stage that the capacity and performance of each of the individual self-contained units are determined and design of the auxiliary systems such as the internal water supply, gas and steam pipeline network, power distribution, and communication systems and plant control schemes are developed. Detailed working drawings including civil work drawings for the foundations, erection and installation of the plant equipment, and the related structural work drawings are also prepared.

During the third stage, the detailed engineering designs of the basic and auxiliary plant units and equipment are prepared including shop drawings and the blue-prints for their fabrication. From these drawings, the fabrication of individual plant and equipment items is taken in hand followed by their assembly, erection, and installation at the site. The manufacturers and suppliers of the plant equipment and machinery undertake their test-trials, after assembly at site and rectify any defects observed therein. In some of the technologically advanced countries, market surveys, feasibility studies, etc. are prepared by the companies or the organisations that plan to create these new or additional steel production facilities. Where these facilities do not exist, competent technical consultants are engaged. The third stage pertaining to the preparation of the detailed designs of plant equipment is carried out by the equipment manufacturers and suppliers [illegible]. There [illegible] equipment manufacturers [illegible] have competent [illegible] to assess the validity of

these claims, to supervise the erection and commissioning of these units, and to evaluate their individual and co-ordinated performances. It is due to these reasons that several technical consultant organizations have grown up. Whilst these consultants have an advisory role to play, in practice the responsibility rightly or wrongly assumed by the consultants is so enormous that few clients would ignore their advice. Over the years, consultancy services have grown in strength; and in the discharge of their normal functions of catering to the client's needs and because of their special position as professional bodies, they have acquired a status and expertise which any purchaser or his engineering unit can hardly provide. In this role of a link between the client and the equipment suppliers, they have acquired a position of considerable significance and importance to-day.

It will be outside the scope of this paper to go more deeply into the full scope of work for the Technical Consultants; the latter may also be asked to prepare on behalf of the client, the detailed "Terms of Agreement" for the supply, installation (including civil works), commissioning and guarantee trial operations by the plant and equipment suppliers of the individual shops and of the steel plant as a whole. These guarantee-trial-operations will be adjudged on standard "norms".

In preparing the Detailed Project Report, the following aspects could also be covered on the basis of prior mutual agreement between the client and the technical consultants.

- Soil investigations studies including water-table studies and drilling of bore-holes for determining load-bearing tests in the area recommended for the site location of the plant with a view to determine the most economic and the best possible layout of the proposed plant and its ancillary facilities.

- Determine the requirements of power, water, fuel oil, steam, compressed air, and other service needs.

- Study the flow of incoming and outgoing materials and recommend the mode of transport to be adopted therefor.

- Prepare the summary and detailed breakdown cost estimates for each facility indicating separately the cost of civil work, structural work, main and auxiliary mechanical equipment, main and auxiliary electrical equipment, etc. In all these estimates, foreign exchange and local currency requirements for indigenous equipment, etc. should be indicated. Prepare all documents required by the Government and financial agencies for procurement of foreign exchange for the imported equipment and machinery.

- Prepare the detailed management and manning schedules for the integrated plant.

- Ensure predetermined degree of standardization of common facilities inter alia the lubricating system, pipe and pipe fittings, cable ducts, instruments, communication system within the plant, pumps, bearings, consumable spares and other replacement items, etc.

- Prepare designs, drawings, and flowsheets to enable detailed specifications to be formulated for all items of work. Basic engineering work should inter alia include designs and calculations necessary for carrying out the construction work for all the stages. Make all stress calculations, complete designs and scantling drawings, configuration sheets and clearance diagrams, details of anchor bolts, reinforcement and bar bending schedules and embedded steel.

- Likewise, designs and working drawings for all services will be prepared. Also, prepare the layout and arrangement drawings for all electric substations, control rooms, motor rooms, and electrical distribution system.

IV. EVALUATION OF THE SERVICES OF TECHNICAL CONSULTANTS FOR THE ESTABLISHMENT OF THE STEEL INDUSTRY IN DEVELOPING COUNTRIES

Evaluation of the services of technical consultants in developing countries can be undertaken on the basis of the success of the steel project in terms of its technological performance and financial projections. The fees to be paid by the client to the technical consultant are directly related to the overall capital costs worked out by the technical consultants for the steel project. Any increase in the capital cost of the project (estimated or actual) will lead to escalation of consultant's fees. The natural desire of the consultants (developing countries are highly desirable clients) is to secure the contract and sign the agreement with the developing country. In order to do so, sometimes the technical consultant may in preliminary negotiations underestimate the capital costs of the project in order to make the latter look highly attractive to the client and secure the contract. Likewise, the technical consultant may estimate the comprehensive production costs (including operational cost plus depreciations and overheads) to attractive low operational figures, in trying to align them to international levels. Several assumptions and deductions are introduced into these estimates and calculations, even to the extent of holding out possibilities for the developing country to profitably enter the export steel markets when the internal steel market demand is low. The developing country frequently lacks the indigenous base to scrutinize these estimates technically, leave alone challenge them; sometimes another technical consultant is engaged to do so. With the agreement duly executed by the two parties, the stage is set for the invitation of tenders (global or country-wise) for the supply of capital plant and equipment. The price escalation clauses that figure somewhat unobtrusively in the equipment supply contracts are almost invariably fully enforced in the ultimate bills of payment.

International Consortia

Quite often an international consortium of equipment supply firms is set up to assist a developing country to set up the steel industry. This consortium also takes upon itself or is given the task of assisting in capital formation on favourable terms (equity partnership, e.g.) and/or to secure the much needed loans from international financing agencies.

In such cases, the invitation to tender for the supply of steel plant equipment is confined to the firms constituting the consortium only and they settle amongst themselves which firm would supply what and at what prices. The developing country has little choice in the matter since it needs assistance in securing capital funds and depends very much upon the consortium in this respect. The experience of some developing countries in working with such consortia in establishing their steel industry has not been always happy. The technical consultants are sometimes pre-stipulated by the consortium and chosen from amongst their own teams.

In the case of developing countries which go in for public sector steel enterprises aided by long term loans and favourable credit terms from friendly countries, the picture follows a somewhat different pattern. Thus, if a friendly country provides the loan in full or part to cover the foreign-exchange component of the integrated steel project, quite frequently the tender invitations for the supply of steel-plant equipment are confined to the firms of that country only; this may limit in some cases the efficiency of the new plant. Even if in some cases global tenders are resorted to, the steel-plant specifications may be adjusted to suit the equipment suppliers of the country providing the credit. These are not hypothetical possibilities. There are quite a few examples to illustrate these features in the case of developing countries. Of course, in such cases, the State ultimately pays the capital costs for the steel plant, but, in the final analysis, it is the consumer who has to pay higher prices for indigenous steel.

Guarantee Clauses

One important gap in the contracts and agreements entered into with steel-plant equipment suppliers related to the omission of "plant operational guarantee clauses" with or without supplementary "penalty clauses" (apart from the clauses contained in the standard "force majeure"). The necessity to do so arises out of the following factors:

In the normal practice of inviting tenders for iron and steel plant and equipment, it is open for different firms to advocate their own views and technical solutions in support of the equipment they manufacture.

In other words, in inviting tenders, the various offers and bids received do differ in their technical contents as also in their capital costs and ultimate prices. However, in doing so, the tendering firms do normally furnish their reasons for departing from the basic plant specifications inserted in the tender papers. In examining however, such tender offers and the reasons advanced by the firms, the client and, on his behalf, the technical consultant has to exercise his own technical judgement and experience since the position invariably is that each firm advocates its "reasoning" and advances its technical views in order to gain acceptance of its tender and capital prices.

In dealing with these situations, which are normal features of such a trade, it is customary to add the "plant operational guarantee clauses" and supplemented by "penalty clauses" - the former guarantee the plant's operational performance in terms of its attaining the specified production capacity, and the latter, in some cases, impose a penalty on the suppliers of the plant equipment, including "turn-key" suppliers, should the plant fail to achieve its specified production capacity over an agreed test-trial period. In some cases, however, penalty clauses are excluded and the final payment to the equipment suppliers to the extent of say 20 per cent of the total contractual value, is made only after the "plant operational guarantee clauses" have been effectively satisfied based on the completion of the satisfactory test trials, covering attainment of specified production capacity consistent with optimum production parameters (such as "coke rate", etc.). Additionally, in some cases, the contracting firm has to supply the plant's "spares" without any additional charge over a fixed period (parts as would not need normal replacements during this period).

The omission of the above clauses can lead often to paradoxical situations. It has been observed in a developing country that confronted with highly unsatisfactory performance of the plant, the supplier of the latter insists on selling additional ancillaries to rectify the deficiencies in the plant's performance. There are actual cases, in developing countries where an entire sintering plant had to be revamped and iron-ore washing units added later on in the circuit originally not designed to include

them, involving heavy additional capital costs. Such a situation could well have been avoided, had the original contract included the "plant operational guarantees clauses". These illustrations can be multiplied and are based on some actual cases of iron and steel plant installations in the developing countries.

V. SOME OF THE SERIOUS DEFICIENCIES OBSERVED IN THE PROJECT REPORTS PREPARED BY TECHNICAL CONSULTANTS FOR THE DEVELOPING COUNTRIES

Some of the main deficiencies in the project reports prepared by technical consultants relate to the following:

1. Improper matching of steel-plant constituent units, viz. coke ovens, blast furnaces, steelmaking, the rolling mills and finishing departments,

2. Recommending unproven technological processes and/or of these processes aiming at increased supply of plant equipment.

3. Unsuitable plant locations, layout, and services, etc.

4. Underestimation of capital charges (depreciation, overheads, etc.) and capital recovery charges.

5. Techno-economic study lacks depth and detailed analyses in relation to capital equipment and investment costs (local currency and foreign exchange components).

6. Underestimation of operational and production costs.

The technical consultants sometimes recommend the establishment of the steel industry in developing countries based wholly on imported raw materials and on other assumptions as outlined in the following pages. In the case of one developing country, the steel industry's establishment was recommended on the following basis:

Almost all the basic raw materials including coke were to be imported including coke from Europe to be transported half-way round the world. The unavoidable degradation of the coke during handling at the two ends and ocean and internal transport, etc. to sizes below one inch (2.5 cm) was not taken into account. It was well known that sizes below one inch of the coke should preferably be avoided in the blast-furnace burden to reduce heavy tuyere losses and lower high coke rate. Such degradation of the coke during port handling and ocean and surface transport is known to be of the order of 15 - 20 per cent and can represent abnormal loss in terms of high coke imports per ton of iron unless the -1" coke is crushed to be charged into the sinter. If a sinter plant had also to be set up at the site, much cheaper high-grade iron-ore fines could have been considered for imports for sintering them to provide the feed to the blast furnace rather than the import of high grade lumpy iron

ores. The burden materials lacked a balance with lumpy iron ore, pellets and self-fluxing sinter proposed to be charged together into the blast furnace. A coke rate of the best Japanese blast-furnace practice was arbitrarily assumed in the projected steel plant which was yet to be installed. The exceedingly high blast temperatures and heavy fuel injection with or without oxygen enrichment of the air blast, backed by fully effective computerized control operations which characterize the best of Japanese blast-furnace technological practice can well be followed on paper but are not so easy to implement in actual practice in the case of developing countries; even some of the advanced steel-making countries have not been able to match the Japanese performance.

The capital costs of heavy labour installations for a deep-water coastal steel plant, of the Japanese type, were not taken into account, leave alone the effects of their capital charges including overheads, depreciation, and amortization thereof on iron and steel production costs. To permit heavy ocean-going raw-material carriers, needing drafts of about 60 feet, to berth for unloading, alongside the ore-bedding bay and in parallel with the blast furnaces in itself represents heavy capital-cost installations of the order of 30 - 50 million US dollars, almost wholly in foreign exchange in the case of developing countries. And, of course, it is very easy on paper to keep referring to and quoting the modern integrated Japanese coastal deep-water steel plants based on imported raw materials whilst in practice it is most difficult for developing countries to follow suit, lacking as they do the resources of capital, technical know-how, and trained manpower and when even some of the advanced steelmaking countries have not been able to match the Japanese low-cost steel-plant installations and performance. The capital costs per annual ton of steel for Japanese coastal deep-water steel plants have indeed been lowest in the world and often of the order of 130 - 150 US dollars whose the corresponding figures for some of the advanced steel-making countries are more than double and for some developing countries of the order of three to four times the Japanese capital costs per annual ton. It is, therefore, most essential to be most cautious when citing the [illegible] and advocating a developing country to follow them. Even the capital cost of a deep-water harbour installation

for such a coastal integrated steel plant would be of the order of 30 - 50 million US dollars and which could strain the resources of a developing country, lacking as it does the indigenous technical means and home capital resources to install them. Giving an actual example, the port development coastal plant currently under implementation at East Intercourse Island, near Dampier in Western Australia, for iron-ore loading, etc., will cost no less than 65 million US dollars with a berthing draft of over 60 feet which is of the same order as would be needed for a coastal integrated steel plant; whilst advocating the latter, its capital costs were either totally ignored or heavily under-estimated in the case of a developing country.

It is often stated that the capital, operational, and production costs analyses have been based on the European patterns. Such a pattern for developing countries is untenable. In the case of developing countries, the corresponding capital costs have to be raised often by 15 - 20 per cent even while not taking into account the foreign exchange charges for long-distance ocean freight, port handling, internal transport, customs, and other levies besides higher costs of civil works, foundations, erection and commissioning, expatriate expenses, etc. In some cases, there are examples where these capital costs for a developing country when taking all these factors into account, are almost double the European capital costs. In some cases the capital-cost figures and production costs are estimated on purely arbitrary basis without due relationship to realistic and practical considerations. As such, the capital and production cost figures given in project reports cannot be accepted as sacrosanct; there may be quoted case examples from developing countries, wherein the capital, operational, and product cost figures given in the project report can be seriously disproved. The entire economic analysis is often sketchy and lacking in precision and depth; well accepted standards of capital recovery charges are sometimes ignored or minimally included.

The production cost estimates at various product levels are made much on the lower side, sometimes excluding or partly taking into account the heavy overheads, depreciation, interest on fixed capital and working capital, loans and capital recovery charges.

It is sometimes stated in the project reports that production cost calculations are made in accordance with European experiences. Such an approach is fallacious in the case of developing countries, which cannot reproduce in toto the European practices. There is nothing derogatory in such a submission since the developing countries very often lack the technical base of trained manpower and high-level management for the integrated iron and steel industry. The plant equipment and machinery spares and auxiliaries have also to be imported at high costs and very often in developing countries these cannot be foreseen. The operations of a heavy integrated steel plant on highpeak economic productivity in a developing country take years to achieve and in its wake, high production costs are not the exceptions but the rule. There is no point in idealising on these practical factors - the sooner these are accepted by the technical consultants, the better it is for the steel industry in the developing countries.

A correctly prepared feasibility study will in any event enable the client or financing institution such as the World Bank (IBRD) to decide whether the project is techno-economically sound and should be pursued or whether any modifications are required.

The technical consultants commissioned for the preparation of the feasibility study must be prepared for requests for further investigations from the client, the bankers and the Government, e.g. those concerned with the granting of import licenses, etc. in a developing country.

In some developing countries, the question of profitability of the State-owned steel enterprise is relegated to one of secondary importance in view of the pressing need to conserve foreign currency spent on steel imports.

In one country, for example, about 350 million US dollars are spent on annual steel imports at present. In other developing countries, this figure may be higher or smaller but nevertheless it represents a heavy drain on foreign exchange resources and balance of payments of the country. The profitability of the highly capital-intensive steel industry even in advanced countries cannot be compared with that of the consumer goods industry because of the huge sums charged to the depreciation, amortisation, and overheads in case of the steel industry.

In some cases, tariff protection and State subsidies have to be granted by the Government to the nascent steel industry in a developing country at least over the initial years as in the case of India.

One important step in the case of developing countries which technical consultants may sometimes overlook is the initial capacity vis-à-vis the final expansion stage capacity. Numerous examples could be quoted where the planned capacity was excessive, with the result that operations were uneconomical for many years. On the other hand, the initial capacity and the final expanded capacity must have a reasonable ratio. For example, an initial capacity of 50,000 tons per year and the final-stage capacity of five million tons per year cannot be recommended or matched. A ratio of one to five for the initial and final stages should not be normally exceeded.

Another important point sometimes overlooked by the technical consultants is that sufficient spare parts must be available at the new steel works for at least one year of operation. The drawing must be prepared of the items most needed for spares and manufacturing facilities arranged to ensure that the required parts can be made in the country. After some years of operation, the original supplier of the steel-plant equipment is unable to supply the spares since he has moved on to more advanced, sophisticated, and newer types of the steel plant equipment and cannot supply the spares for the original plant either totally or in some cases, can do so only on the payment of exorbitant charges. Most technical consultants tend to overlook these points and there are actual examples to illustrate these points in the case of developing countries.

The choice of technological processes and the economic considerations tend often to be based on non-technical factors in the case of developing countries where the selection of process technology and the related plant equipment are inevitably linked with the particular supply of iron and steelmaking capital equipment by the country which provides the technical and/or financial aid. Thus the choice of a technological process and the operational flowsheet has to be qualified by the country's financial resources, the market pattern and its future projections, the financial capital outlay and the least foreign exchange component involved; the process thus selected may not be the best technically but could nevertheless be those that would enable a country to meet the recurring demands for capital spares and technical trained personnel.

The application of a particular latest process in a developing country cannot be accepted as automatic or automatic. Any new or the latest process has to [illegible] over a substantial period before it can be recommended for application elsewhere. Many such processes could fall by the way-side in a developing country, possibly because the local background conditions of instrumentation, automation, and mechanical control have not been sufficiently developed. Apart from the capital outlay and foreign exchange resources, other factors would relate to the availability of raw materials, steel scrap, and fuel resources.

The capital-cost estimates prepared by well established international technical consultants go awry in the case of developing countries and the production costs more so; those estimated by the international technical consultants in their detailed project reports do not apply in actual practice.

The capital costs, likewise go up by over 100 per cent in some cases for actual installations compared for those estimated in the detailed project reports prepared by well-known international technical consultants. The reasons for these anomalies are not far to seek. The one basic aim of international technical consultants appears to be to get their project reports accepted by developing countries with themselves firmly wedged in. The poor developing country finds the international technical consultants getting more firmly entrenched with each justification provided for the escalation in the capital costs of the project and increase in the actual production costs of the steel and its products. The developing country at that stage finds itself confronted with and hedged by so many innocuous-looking legal clauses introduced by the international technical consultants and innocently well dispersed in the "Agreement" signed by the two parties that the developing country has no choice but to give in.

VI. EVALUATION OF CONSULTANCY SERVICES TO PROMOTE CAPITAL INVESTMENT (domestic and foreign) FOR THE IRON AND STEEL INDUSTRY IN DEVELOPING COUNTRIES (capital financing on equity basis, capital loans from international banking and financing agencies, capital financing on a consortium basis involving one or more firms and/or countries, capital financing and loans on bilateral basis.

Capital financing for a highly intensive steel industry is a complex subject, particularly in the case of developing countries. The international technical consultants often act as promoters for the capital investment of the steel projects in developing regions and countries when they use their feasibility studies, techno-economic evaluation and/or detailed project reports with capital financing agencies such as with the IBRD, IMF, and private banking organizations. Quite often the technical consultants obtain the steel-plant equipment from different advanced countries with their respective Governments offering suitable long-term credit terms to the developing country. While much can be said in favour of such arrangements, the developing country has no choice but to accept whatever price tag is laid on the supply from different advanced countries of the plant equipment and which is often much higher than their world market prices; in such cases, the same technical consultants act as promoters for the sale of plant equipment on long-term credit terms on behalf of the equipment suppliers and not infrequently lucratively from both the sides.

In some cases, the developing country agrees to the participation of the foreign firm on capital equity basis to the extent of the foreign exchange requirements of the steel project, while the indigenous costs for civil work, building, and local fabrication of the structural works and of such equipment as can be locally manufactured, are met by the developing country. This, of course, depends upon the policy of the developing country concerned. Whilst in this case, the profits of the steel project are divided appropriately between the two parties over a long mutually agreed period (10 - 20 years) or indefinitely, the management of the project is shared on the basis that the chairman (or president) of the board belongs to the developing country and in some cases vice-versa.

Much can be said for and against these arrangements and there is no universal yardstick to adjudge their respective merits. International technical consultants do, however, succeed in playing a double role in these financial transaction.

Capital financing of the steel industry on bi- or multilateral trade agreement is much less implemented but has been followed in the case of a few developing countries when the payments in foreign exchange (for the supply of the steel-plant equipment and technical expertise including technical consultancy services) are made on a long-term basis through financial adjustments of exports from the developing country of traditional items (tea, coffee, jute, cotton, textiles, hide, skins and leather goods, etc.).

Capital financing on a wholly indigenous basis in a few developing countries has been successful for putting up small iron and steel plants. In these cases, the capital costs of the plants in local currency have been reasonably high (in equivalent foreign currency) but no higher than what would have ultimately been the case against foreign bank loans and long-term credit.

Vast capital is required for installing a new integrated steel plant on the basis of accepted economies of scale using conventional production technology, e.g. a million tons integrated plant for a mixed product-mix and upwards - a three million tons steelmaking facility for flat products continuous strip mill. Depending upon the product-mix, the capital needs could range from 200 million US dollars to more than 600 million US dollars. These figures go exceedingly well with access to potential markets (internal or export-based) and plentiful sums of capital. But what happens in the case of developing countries lacking as these do huge market and equally large capital resources.

VII. CONCLUSIONS

Conclusions in a study of technical consultancy services for the iron and steel industry in developing countries would tend to merge into one basic theme, that developing countries must develop their own technical consultancy services as speedily as they wish their steel industry to grow. This is a lesson which relatively a few developing countries have indeed learnt. The task is not easy but it is also not insurmountable. Good start and success have been achieved by some developing countries. Even though the iron and steel industry is highly capital-intensive, it cannot be left to the vagaries of international trade and barter arrangements to meet the iron and steel requirements for almost unlimited applications in expanding industries of the developing world. The growth of technical consultancy services in developing countries should really precede or at least proceed pari passu with the development of the iron and steel industry in these regions. The development of technical consultancy services for the iron and steel industry in the developing world, despite acute shortages of trained specialists and consultants, would represent a self-sustaining growth and not a super-structure with an alien base. Those who argue that the developing countries should continue to draw upon the experienced technical consultancy services of industrially advanced countries conveniently overlook the position that the latter will also continue to draw upon the scanty financial resources of the former. This would continue to be so despite any claims to the contrary. If money is plentiful, it is cheap and if money is in short, supply, it is expensive as in the case of developing countries.

It should not be forgotten that the industrially advanced countries leading in steel production to-day have passed through the same process of self-sufficiency in technical consultancy. While much can be bought "off-the-shelf" at a price, the same price can be paid for developing an in-built technical consultancy service in the developing steel world. No matter what is argued for or against, this objective is quite clear and cannot be lost sight of to those developing in the steel industry despite the maze of endless discussions.

According to ILAFA [1] estimates, the Latin American industry would require some 2,500 million US dollars to complete the expansion plans of the existing iron and steel plants and for the new projects during 1965 - 70

Likewise, for the developing countries in ECAFE [2] region, the estimated requirements are of the order of 1,800 million US dollars during 1963 - 70, for the steel industry's plans.

In Latin American countries, European interests have made huge investments in the steel industry; in recent years, however, foreign collaboration has taken the form of sale of equipment and licenses to public and private sector steel enterprises in conjunction with international banking institutions such as the IBRD, IFC, IDB [3], etc.

The total investment [4] by developing countries over 1965 - 70 has been estimated at 7,200 million US dollars with a foreign exchange component of about 4,500 million US dollars.

While some of the developing countries [5] have had comparatively high growth rates in steel production capacity, the tonnage increase on the whole has been low; the share of developing countries in world steel output rose from 1.5 per cent in 1950 to 3.8 per cent (17 million tons) in 1965 which represented an annual growth rate of 12.7 per cent compared with 5.6 per cent in industrialised countries. The steel production

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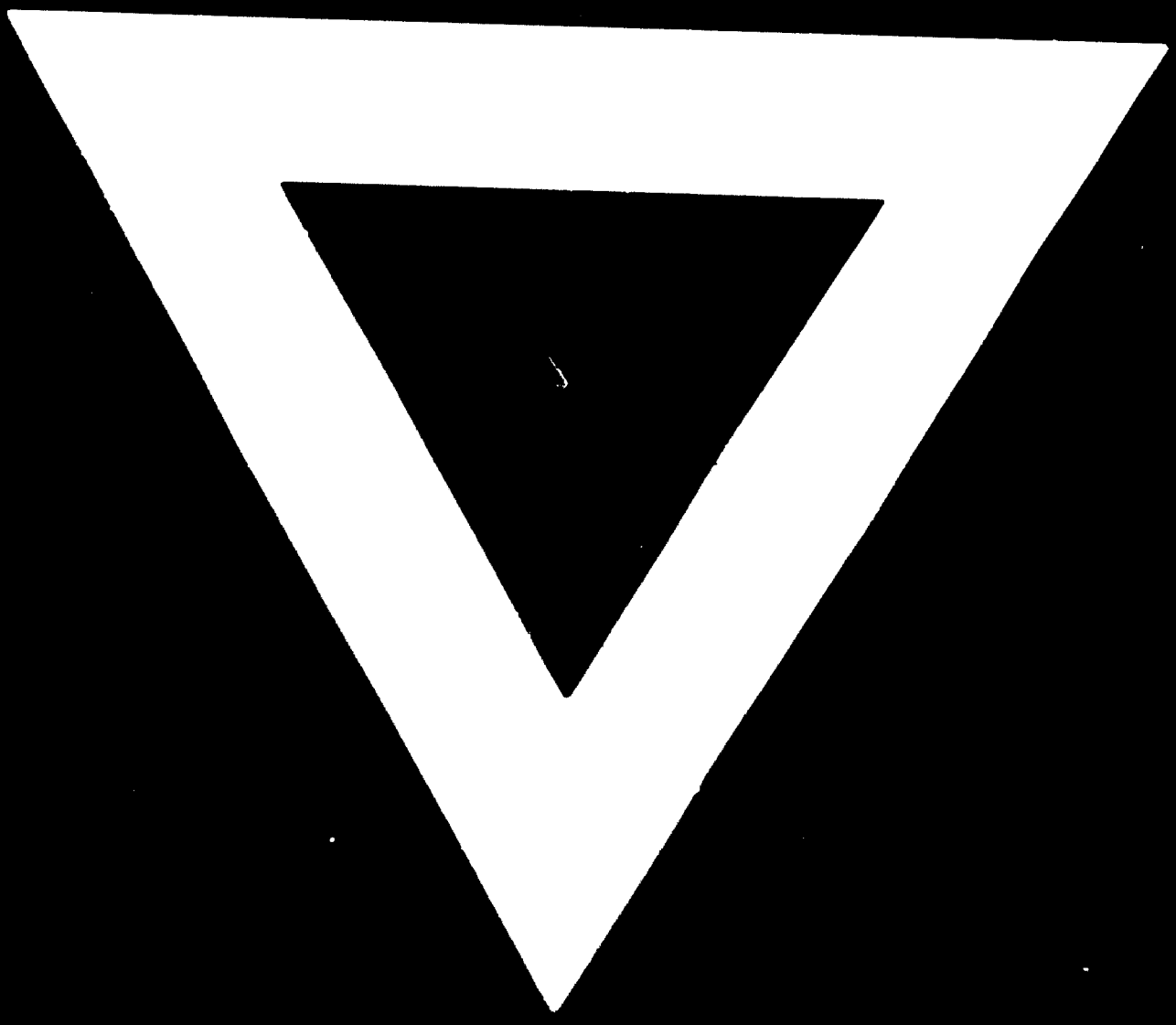
1/ Mario Sáez Escudero. Das Wachstum der Eisen- und Stahlindustrie in Lateinamerika - Stahl und Eisen Vol. 87, No. 19, 21 September 1967 pp. 1163-66.

2/ UN Economic Commission for Asia and the Far East: Industrial Development in Asia and the Far East, Vol. 4, Development of key industries - New York, 1966, pp 26 ff.

3/ [illegible]. Economics of steel plant installations and operations in developing countries. Joint meeting in India of the National Metallurgical Laboratory, [illegible], of Instituto Latinoamericano del [illegible] [illegible] Institute of Metals, on [illegible] and [illegible] of Steel Plants in Developing Countries", [illegible] and 39.

4/ and 5/ [illegible] and 52

capacity of the developing countries is expected to double itself by the end of 1971 and almost double again by 1975. The strain on the resources of the developing countries in terms of money, men, and material in the wake of these expected developments will be tremendous. The technical consultancy services of developed countries will be in great demand. At the same time, developing countries must develop their own technical consultancy services best suited to their characteristic environments and conditions - political, technical, and monetary.



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