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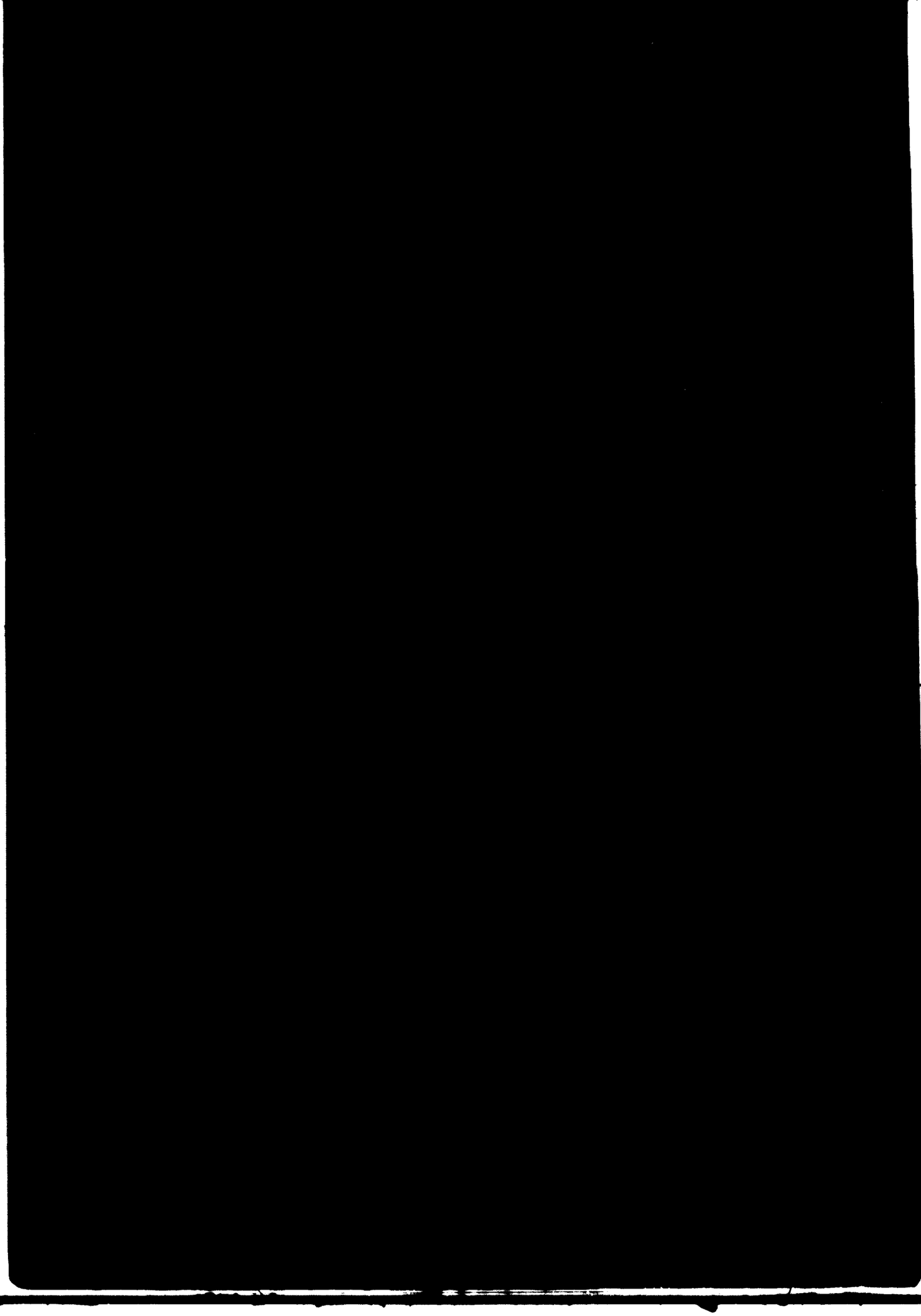

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Preparatory Meeting for the First Consultation
Meeting on the Iron and Steel Industry

Vienna, 7-11 December 1976

BACKGROUND AND SUPPORTING INFORMATION ON ISSUES WHICH MIGHT BE SELECTED FOR CONSIDERATION AT THE CONSULTATION MEETING

prepared by
the secretariat of UNIDO

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Explanatory notes

For the purpose of this paper the following definitions have been used:

Developed countries: Eastern and Western European countries (including Turkey), Canada, United States of America, Australia, New Zealand, Japan and South Africa.

Developing countries: Countries other than developed countries as defined above. They were divided into the following groups for the sake of convenience: Sub-Sahelian Africa; Arab countries; America (Central and South America); South Asia (Afghanistan, Bangladesh, Bhutan, India, Iran, Nepal, Pakistan, Sri Lanka); South East Asia (Brunei, Burma, Democratic Kampuchea, Indonesia, Lao People's Democratic Republic, Malaysia, Philippines, Singapore, Thailand, Socialist Republic of Viet Nam); East Asia (China, Democratic People's Republic of Korea, Mongolia, Republic of Korea).

References to "dollars" ($) are to United States dollars.

References to "tons" are to metric tons.

The term "billion" signifies a thousand million.

Unless otherwise specified, all figures of steel production and consumption refer to raw steel (ingots) equivalent.

Unless otherwise specified, statistical data were taken from:

United Nations Statistical Yearbook, 1974

Various issues of United Nations Monthly Bulletin of Statistics

UNCTAD Handbook of International Trade and Development Statistics, 1976.

This paper is based on an informal background paper titled "Problems and Opportunities in the World's Iron and Steel Industry"[1/] prepared by the Industrial Operations Division of UNIDO for reference in operational activities (17 November 1976).

The background and supporting information on Issue 7 is based substantially on the contribution and collaboration of the UNCTAD secretariat in compliance with resolutions adopted at the Second General Conference of UNIDO in March 1975 and at UNCTAD IV in May 1976.

1/ UNIDO/IOD.50.

INTRODUCTION

A. The consultations

The First UNIDO Consultation Meeting on the Iron and Steel Industry will be convened in Vienna, 7-11 February 1977. The objective of the Meeting is to explore problems and opportunities related to the expansion of the world iron and steel industry, giving particular attention to the need to increase the developing countries' share in world steel production and consumption.

1. The purpose of the Preparatory Meeting

A preparatory meeting is being convened as part of the preparations for the First Consultation Meeting. The Aide-Mémoire announcing the Meeting included as an annex a tentative list of issues suggested for consideration at the preparatory meeting. The background to those issues has been elaborated substantively in this paper.[2/]

The participants of the preparatory meeting will discuss the seven issues and any additional issues relevant for consideration at the Preparatory Meeting with a view to selecting a limited number of important issues that can be discussed at the First Consultation Meeting, bearing in mind that other issues could be considered at the future consultation meetings on the iron and steel industry.

This paper provides the background and supporting information on the seven issues,[3/] with the ultimate objective inter alia of suggesting possible ways and means by which co-operation could progressively be built up between developing and developed countries and between developing countries themselves. In considering which issues are most suitable for the Consultation Meeting, participants are invited to suggest which specific points offer practical and useful suggestions for international co-operation.

2. The need for consultations in the iron and steel sector

A sectoral consultation meeting, in the sense implied by the Lima Declaration, ought to consider a particular industry in the context of its world setting. This is particularly necessary in the case of an industry that is as highly capital intensive and consumes such vast quantities of raw materials as the iron and steel industry. The issues for consultation on the growth of the iron and steel industry at the national, regional or inter-regional level are inevitably linked with future expansion plans and the possibilities of implementing them. It is in the area of implementation that developing countries encounter constraints due to

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2/ The word "issue" as used here is intended to mean "points for discussion". It is translated in French as "questions" and into Spanish as "los puntos sugeridos" (the points suggested). These translations reflect the co-operative spirit in which points suggested for discussion at the Consultation Meeting might be considered.

3/ The seven issues and specific points within each issue have been identified by the internal task force established by the Executive Director of UNIDO to prepare for consultations on the steel industry.

limitations on sources of capital, a shortage of trained manpower and an embryonic technological base. The issues therefore centre on a number of principal topics and problems that this paper attempts to highlight.

Steel is the main construction material in a modern economy, and the developing countries have large needs and capabilities in the iron and steel sector. The present situation and prospects for a general expansion of the world's iron and steel industry must therefore be considered in the light of the new economic and political realities, and international co-operation must be promoted to ensure that expansion is rapid and equitable.

For the developing countries, the expansion of the iron and steel industry is an economic imperative, mainly to satisfy their own demand.

For developed countries, there are particularly attractive opportunities for co-operation with developing countries in the establishment of new capacity or in trade.

It will be also necessary to develop and/or to secure the raw-materials supplies needed for the smooth expansion of the sector in the developing countries themselves.

The growth of the iron and steel industry in the world therefore depends on a number of factors. These can be discussed at a consultation meeting by industry experts and representatives from the developing and developed countries with a view to creating a favourable climate for co-operation and eventual negotiations aimed at promoting a global growth of the iron and steel industry based on acceptable techno-economic parameters, with due emphasis laid on the expansion of the steel industry in the developing countries.

Further consultations on the iron and steel sector between developed and developing countries are likely to be required in the future. They may be direct or promoted through UNIDO and other relevant international bodies of the United Nations.

B. The present situation of the world iron and steel industry

1. The significance of the iron and steel industry for the world economy

The significance of the iron and steel industry for the world economy is indicated by the following:

(a) It produces the most essential material needed in a modern economy at a relatively low cost

The products of the iron and steel industry - plate, sheet, bars, rods, wire, heavy and light sections, tubing etc. - are essential for the production of industrial equipment, industrial buildings and installations; power, transportation, communications and water distribution networks; housing; and durable consumer goods. Some of its by-products are also important for the operation of subsidiary industries: pig iron is needed for cast iron foundires, coke by-products are used in the chemical industry, and slag is used for the production of cement, glass wool and aggregate materials. The strength and ease of fabrication of steel, combined with its low cost, make it the most essential of all materials used in modern industry. Total world production reached 695 million tons in 1973. In spite of

price fluctuations, especially in the period 1973-1976, steel continues to be cheaper than any other metal and, if its strength and durability are taken into account, cheaper than most other construction materials.

(b) The value of its production in a dynamic economy is a significant part of the GNP

The gross value of the products and by-products of the iron and steel industry is at least 2-5 per cent of the GNP in an industrialized economy and may reach 6-8 per cent in countries where the GNP is growing rapidly and steel production is keeping pace with needs. If the indirect effect of steel production, based on the gross value of all products and structures made from steel, is considered, the corresponding percentage of GNP might reach values of the order of 20 per cent.

(c) Its operation involves the transportation and handling of very large tonnages of raw materials and products

The sheer weight of materials and products that have to be handled and transported for the operation of the world steel industry is huge and makes the industry highly dependent on infrastructure. About three tons of ore, coking coal, outside scrap, oil and fluxes are needed to produce one ton of steel. Marketable output is roughly one ton per ton of steel ingot produced. So a country producing 100 million tons of steel a year must secure a yearly supply of some 300 million tons of raw materials and an outlet for some 100 million tons of products, by-products and other materials.

(d) It is a capital-intensive industry, requiring heavy investments for its establishment and operation

The iron and steel industry is notably capital-intensive, with a specific requirement of $600-$1,200[4/] for each ton per year of new steel ingot production capacity. In addition, in certain cases, particularly in developing countries, substantial infrastructure investment has to be made. The establishment of an integrated iron and steel plant with a capacity of one million tons a year (ingots) in a developing country will therefore require an investment of the order of $1 billion. Additional investment "up-stream" (for the supply of the necessary inputs) and "down-stream" (for the processing of steel into manufactured products) will also have to be taken into account and may also be of the order of $1 billion. A large portion of the capital invested in iron and steel installations (some 50-70 per cent) corresponds to heavy industrial equipment and heavy industrial construction, and the iron and steel industry is therefore a large buyer of heavy capital goods.

(e) It depends greatly on multidisciplinary know-how and technology

In an industry handling very large amounts of materials and products in large installations, and delivering relatively cheap products to the national and international markets, know-how and technology are of decisive importance, particularly to ensure productivity and quality. A constantly changing pattern of sources, characteristics and prices of raw materials; changing conditions and requirements regarding the ecological effect of large industrial installations; new developments relating to the sources and costs of labour and capital; and a changing market picture - all these have made technological development an imperative for the continued growth of an efficient iron and steel industry. Especially significant changes have taken place in the technologies of processes and products in the last two decades, and further radical changes are likely in the next two.

4/ Depending on size, technology, location and infrastructure, and relationship to previously existing plants and other related industries.

(f) A large share of international trade is directly related to the operation of ths iron and steel industry

International trade in iron ore, pellets, coking coal, and semi-finished and finished steel products involves exchanges of about 700 million tons per year of materials and products worth about $60 billion. Exports or imports of the raw materials and products of the iron and steel industry are either important sources of income for, or serious drains on the balance of payments of, developed and developing countries alike.

(g) It generates or activates "up-stream" and, especially "down-stream" industries of great economic importance

The iron and steel industry, being a heavy consumer of raw materials, refractoriss, rolling mill rolls (cast or forged), special heavy equipment and components, ferro-alloys, special additives, tin (for tin plate), lubricants, and the like, is dependent on the operation of important "up-stream" industries.

On the other hand, the ready availability of its output is the basis for a varisty of "down-stream" industries producing heavy equipment, agricultural machinery, structures (buildings, bridges etc.), ships, automobiles, tractors, industrial and civil construction hardware, metal furniture, household appliances and utensils, tools, and other similar products.

(h) It is a large consumer of energy

The iron and steel industry uses about 12 per cent of the world's total energy requirements (coal, hydrocarbons and electric power). It must be noted, however, that over ons third of the total fuel requirement is used not for its energy value but as a reductant needed to obtain from the ores metallic iron (mainly as pig iron, which is iron containing carbon, silicon and manganese in solution, besides impurities). The "energy problem" of the iron and steel industry is therefore a peculiar one, and it requires special treatment.

2. A simplified global picture of the sector

The materials flow for the iron and steel industry in 1973[5/] is concisely presentsd in figure I. The figures given in table 1 are a further indication of the size of the industry. The following main features of the industry in 1973 should be noted:

(a) The production of raw steel was 695 million tons; the production of finished products was 556 million tons;

(b) Total direct raw materials input was about 1,700 million tons; some 600 million tons of products were transported to markets;

(c) The total value of all products and by-products of the industry can be estimated at about $130 billion;

(d) Ths value of inputs was $60 billion. The added value in the industry was thus $70 billion, which corresponds to $100 per ton of crude steel;

(e) The developing countries, with 70 per cent of ths world's population, contributed

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5/ 1973 is considered, for the purposes of this papsr, to be the last normal year before 1976. Production was (in millions of tons): world = 695; developing countries = 55; developed countries = 640.

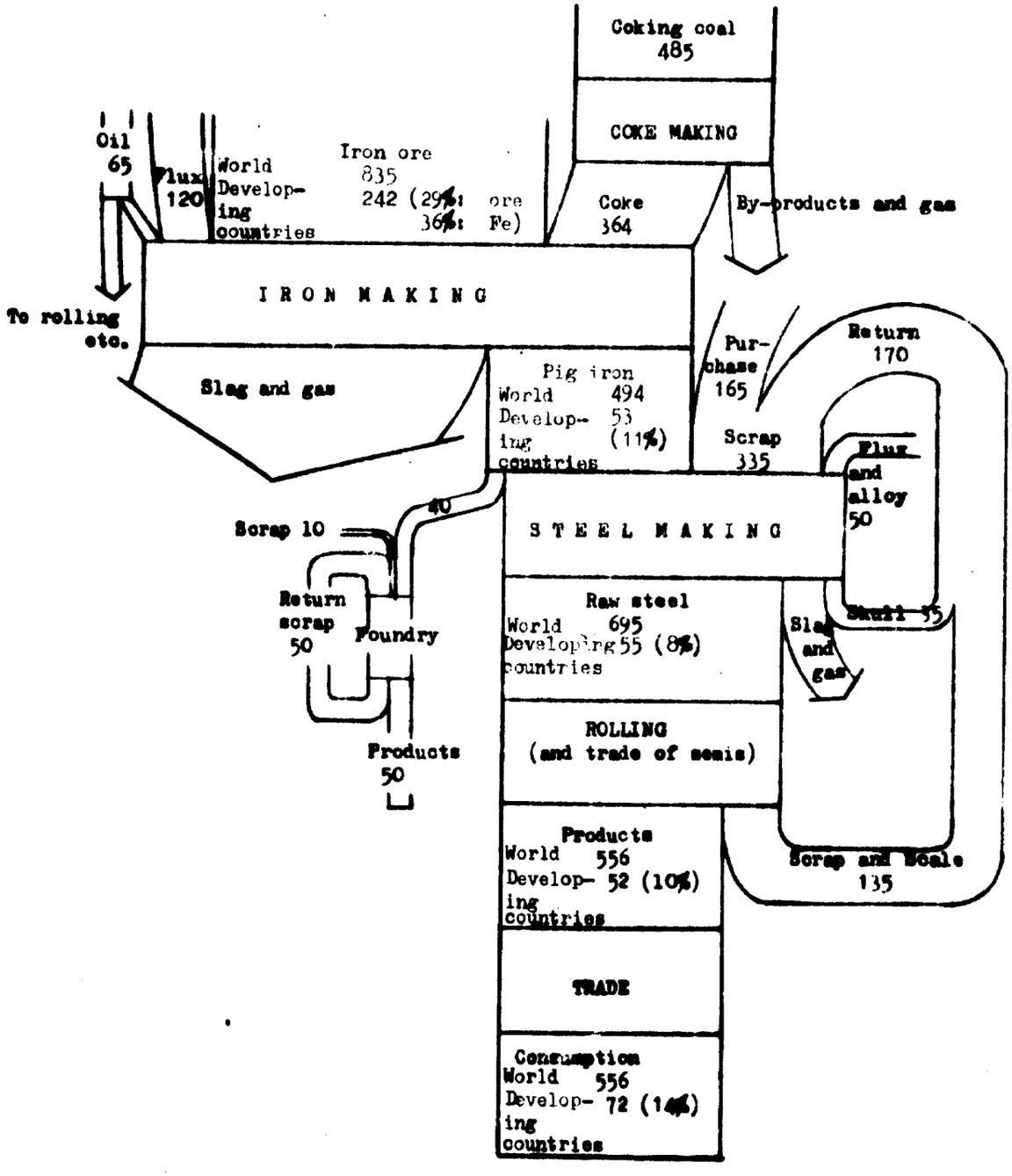

Figure I. The iron and steel industry: global flow chart for 1973 (unit = million tons; figures based partly on data and partly on rough estimates)

about 29 per cent of world iron ore (or 36 per cent in terms of iron content) but produced only 8 per cent of world raw steel while consuming about 14 per cent of world steel products;

(f) The quantities of pig iron involved are huge and indicate that any process designed to replace the conventional blast furnace in the reduction of ore to metal must be capable of operation on a very large scale;

(g) The demand for coking coal has also reached a volume which creates special problems, in view of the very uneven distribution of economic deposits. Unlike iron ore, good coals are available only in relatively few locations in the world and must be imported by most developing countries.

Table 1. Main inputs, intermediate products and final products of world iron and steel industry, 1973 a/

	Inputs		Intermediate products (million tons)	Final products		Unit value ($US/ton)
	Million tons	Value (million $US)		Million tons	Value (million $US)	
Iron ore	835	12,500				15
(Pig iron)			494			
Coking coal	485	26,700				55
(Coke)			364			
Oil	65	2,000				30
Fluxes	140	2,100				15
Scrap	165 b/	8,250	170 c/			50
Other consumables	30	9,000				300
(Steel ingots)			695			
Steel products				556	122,300	220
Other				50	7,500	150
Total	1,720	60,550	1,723	606	129,800	

a/ Data and rough estimates.

b/ Purchased scrap.

c/ Internal process scrap.

3. Recent evolution and growth rates

The world iron and steel industry has grown steadily over the last quarter of a century and has supplied essential low cost materials to the world market. Growth was supported by a remarkable technological development in every aspect of steel production. Since there are many articles and papers on the recent development of iron and steel technology, no review is attempted here. A number of statistical production aspects are presented, however, to outline the broad features of the growth of the sector.

Figure II presents in graphical form the evolution of world steel production since 1948 and the shares of the developed and developing countries. It also indicates growth rates 6/ for various periods. It is seen, for example, that the growth of the industry in the period

6/ All the growth rates were calculated by regression analysis assuming a constant rate of growth in the period concerned.

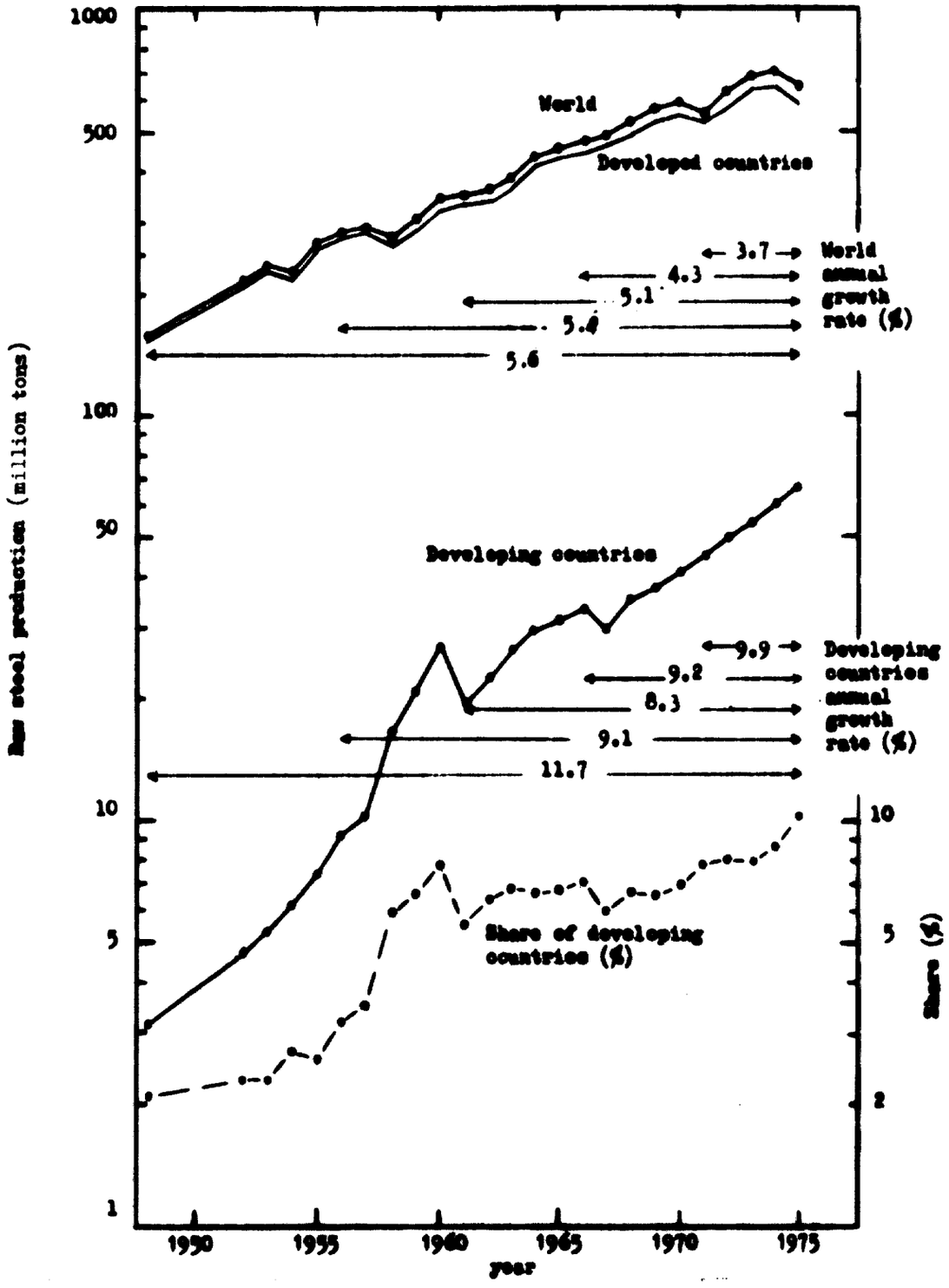

Figure II. Recent evolution of raw steel production

1966-1975 was: 4.3 per cent for the world and 9.2 per cent for the developing countries. In the same period the share of the developing countries grew from 7.1 per cent to 10.5 per cent. This last figure is unusually high because of the sudden drop in world production in 1975. Under normal conditions the share of the developing countries in 1975 would have been about 9.5 per cent.

4. Geographical distribution of steel production

As already indicated (figure II) the developing countries produce only about 8 per cent of world steel (1973). In other words, 2.7 billion people (70 per cent of world population) produced only 8 per cent of world steel, while the other 1.1 billion people in the developed countries (30 per cent world population) produced about 92 per cent of the world steel in 1973.

The above two points alone indicate a striking disparity between the developed and developing countries in the iron and steel sector. The large difference between developed and developing countries in this respect is generally reflected in other indices of production, consumption and standard of living.

Figure III indicates in more deta l the distribution of steel production in developing countries in different regions and sub-regions. It also indicates the corresponding degrees of self-sufficiency. It is seen that developing countries in all regions have a steel deficit and have to rely on imports. This is particularly marked in Sub-Sahelian Africa, in the Arab Community and in South-East Asia. The wide difference in the degree of self-sufficiency in steel between the regions is quite marked.

Steel production is quite unequally distributed among the countries: 20 countries produce 9, per cent of world steel. Nine countries alone produce 80 per cent of the total. An even more striking difference exists between individual countries. Production varies from zero tons/country and zero kg per capita up to about 140 million tons/country and 2,060 kg per capita.

Practically all developed countries have integrated or semi-integrated steel-making facilities. Only 15 of the developing countries have integrated iron and steel plants, most of them quite small; another 30 have very small steel-making facilities based on scrap melting. Many of the latter are now paralyzed or operating irregularly.

The per capita production by regions is indicated in table 2. It can be seen that South Asia, South-East Asia and Sub-Sahelian Africa show very low per capita production and consumption figures. The situation is particularly critical in Sub-Sahelian Africa, which produces only 1.6 kg of steel, per inhabitant, per year. On the other hand, Latin America as a whole seems to be in the "take-off" stage to industrialization and already has an important and flourishing steel industry.

As indicated above, although production and consumption have attained good levels (in total tonnage, per capita values and growth rates) in certain developing countries, in most of them the iron and steel industry is non-existent. These latter countries constitute a special group of "zero steel countries" that merit special attention and assistance to enable them to make a start at iron and/or steel production, for rolled products or castings, even if only in very small integrated or non-integrated plants. Such plants, as demonstrated in developed and certain developing countries, can be technologically and economically viable.

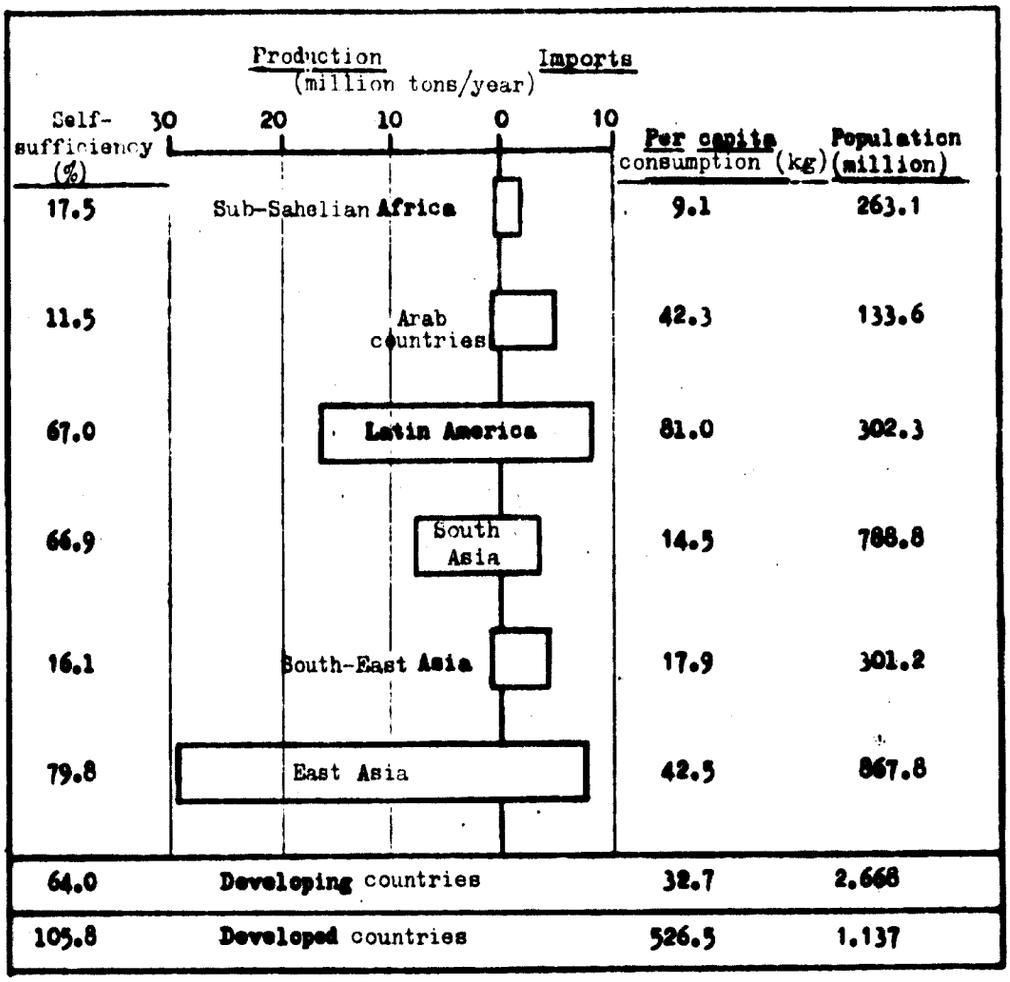

Figure III. Production and import of steel by region, 1973

Table 2. Production and consumption of steel by region, 1973

	Population		Raw steel production		Raw steel consumption		Per capita (kg)	
	Million	%	Million tons	%	Million tons	%	Production	Consumption
Developing	2,668	69.8	55.3	8.0	86.3	12.5	20.7	32.3
Sub-Sahelian Africa	263.1	6.9	0.42	0.1	2.40	0.3	1.6	9.1
Arab countries	133.6	3.5	0.65	0.1	5.65	0.8	4.9	42.3
Latin America	302.3	7.9	16.40	2.4	24.50	3.6	54.3	81.0
South Asia	788.8	20.6	7.65	1.1	11.44	1.7	9.7	14.5
South-East Asia	301.2	7.9	0.87	0.1	5.40	0.8	2.9	17.9
East Asia	867.8	22.7	29.44	4.2	36.87	5.3	33.9	42.5
Developed	1,137	29.8	639.5	92.0	603.7	87.5	562	531
Western Europe	399.1	10.4	178.10	25.6	161.90	23.5	446	406
Eastern Europe	356.9	9.3	178.30	25.7	177.20	25.7	500	496
North America	232.5	6.1	150.20	21.6	163.75	23.7	646	704
Oceania	16.1	0.4	7.89	1.1	8.02	1.2	490	498
Japan	108.4	2.8	119.32	17.2	87.18	12.6	1,101	805
South Africa	23.7	0.6	5.72	0.8	5.64	0.8	241	237
World	3,820		695		690		182	181

BACKGROUND AND SUPPORTING INFORMATION ON SEVEN ISSUES AFFECTING THE DEVELOPMENT OF THE WORLD IRON AND STEEL INDUSTRY FROM 1976 TO 2000

Issue No. 1

THE FUTURE REQUIREMENTS, TARGETS AND DISTRIBUTION OF STEEL PRODUCTION BETWEEN THE DEVELOPED AND DEVELOPING COUNTRIES

Issue 1 (a)

What are likely to be the future requirements of steel in developed and developing countries in the period up to 1985 and in the period 1985-2000?

Taking into account the estimated requirements, what should be the production target for developing countries for the years 1985 and 2000?

Issue 1 (b)

Taking into account the steel production capacity that is under construction and planned in both developed and developing countries, what steps should be taken by Governments and industry in these countries to achieve the steel production targets for 1985 as well as for subsequent years up to 2000?

Issue 1 (c)

What case can be made out for the dynamic growth of the steel industry in the developing countries up to the year 2000, based on technical assistance from the developed to the developing countries and technical co-operation amongst the latter themselves in order to increase the share of developing countries in the world iron and steel production?

Issue 1 (d)

What solutions and national and regional measures could be considered as appropriate for meeting consumption requirements and establishing adequate production capacities in developing countries which currently have little or no steel production?

I. BACKGROUND AND SUPPORTING INFORMATION FOR ISSUE NO. 1

1. Basic consumption projections and production targets

Various forecasts for world steel consumption and production currently made on the basis of judicious consideration, vary from 1,500 million tons to 2,000 million tons by 2000. While the forecasting of steel consumption and production for the developing countries (and world) is difficult, it is even more difficult for developing countries to arrive at forecasts and targets.

Two sets of forecasts might be assumed, however, for the year 2000 - one high and one moderate - on the basis of preliminary analyses and forecasts from various sources.1/ They are:

1/ See UNIDO/IOD.50, pp. 32-41.

	World consumption	Developing countries consumption
	(million tons)	
High forecast	2,000	700-800
Moderate forecast	1,750	500-550

The high forecast is mainly based on the higher estimates of world production by various sources and on a rather high consumption growth rate for the developing countries. The moderate forecast is mainly based on the middle value estimates of world production by various sources, and a moderate growth rate of consumption in the developing countries.

To select a consumption projection as a basis for setting production targets for the year 2000, further detailed techno-economic studies would have to be made. However, in a first attempt to quantify production targets and to identify the corresponding implications, the moderate forecast is tentatively selected, for the following reasons:

(i) The recession experienced in very recent years was the most serious one after the war, and the steel industry was even more affected than most other industries. Full economic recovery may take a few years. Certain expansion plans were shelved, others are being revised or delayed. Furthermore, normal structural changes in the world economy, ecological problems, and huge raw material and energy requirements will pose special problems for the growth of the world steel industry;

(ii) The high rate of growth of steel consumption in the developing countries (8.1 to 9.6 per cent per year for the last 10 to 15 years) may decrease when the total quantity of steel consumed increases and imports become more costly. The supply of low priced steel from the developed countries before the economic crisis was an important factor for the steady development of consumption by the developing countries. It is likely that world steel prices will be generally higher in future, and this will affect imports and consumption of steel by developing countries in the short and medium term;

(iii) Production of steel in the developing countries has also grown at a steady rate (8.3 to 9.2 per cent per year); if it continues at such a rate, it will reach 470 to 600 million tons in 2000. It seems difficult for the developing countries to exceed the past rate of growth appreciably, in view of heavy requirements for the development of inputs and infrastructure;

(iv) The steel consumption forecast for the developing countries (500 to 550 million tons for 2000) implies industrial production growth of about 7 per cent per year. The figure of 7 per cent corresponds to the developing countries' observed growth rate of the last 10 to 17 years. Since an appreciable slow down of industrial production of the world is anticipated (from 7 per cent per year to 4.5 to 5.5 per cent per year) it seems reasonable to assume that the developing countries will not exceed the general 7 per cent growth rate in the next 25 years;

(v) The high projection for developing countries' steel consumption (700 to 800 million tons in 2000) would, however, imply a high level of imports (150 to 200 million tons) if the production of the developing countries grows at the present rate. This would place a very heavy burden on the balance of trade of the developing countries.

The adoption of the moderate forecast of consumption is also consistent with the following considerations:

(a) Considerations based on the Lima target for industrial output. Since the Lima target for the total industrial output of the developing countries is 25 per cent and there are sectors of industry where the developing countries will encounter serious problems in meeting the target (aero-space, electronic industry, nuclear energy generation equipment etc.), the developing countries must do considerably better than reach a 25 per cent share in other sectors. It is assumed here that the 25 per cent value can be exceeded more easily in the conventional basic industries - steel, fertilizers, petrochemicals, and so forth. The consensus of many developing countries' experts seems to be that to reach the Lima target a share of at least 30 per cent of steel production must be reached by the developing countries by 2000. Based on a forecast of 1,750 million tons for world production, the share of the developing countries would be 530 million tons in 2000;

(b) Per capita considerations. If it is assumed that an average GNP of $750 per capita per year (at 1963 value) by 2000 would be a minimum goal, it can be seen from the "steel intensity" curve[8/] that the corresponding apparent steel consumption would be approximately 110 kg per capita. If it is further assumed that by 2000 the populations of the world, developing countries and developed countries will reach 6.1 billion, 4.6 billion and 1.5 billion respectively, it can be seen that a consumption target of 110 kg per capita would give a figure of 510 million tons by 2000, for the developing countries;

(c) Self-sufficiency considerations. As is repeatedly mentioned, imports of steel by developing countries are a heavy burden on their limited foreign currency resources, and achievement of a large degree of self-sufficiency should be a major target of the developing countries as a group. Under the moderate forecast, steel consumption of the developing countries will reach 500 to 550 million tons in 2000. This steel can be produced within the developing countries, if their present rate of production growth can be maintained until the end of this century, which seems a reasonable assumption.

The basic targets for steel production in the year 1985 and 2000 indicated in table 3 can therefore be taken, tentatively and arbitrarily, as a basic projection for reference in discussions and planning. It is emphasised that the figures shown are no more than suggestions for reference and discussion. They can nevertheless be considered as a minimum desirable target and can serve as a basis to identify the order of magnitude of the problems and opportunities facing developed and developing countries.

It is interesting to note that some developing countries have already reached production or consumption figures close to 100 kg/capita. Examples (in kg/capita) are:

Consumption:	Brazil (94)	Republic of Korea (91)
	Mexico (95)	Saudi Arabia (96)
	Portugal (138)	
Production:	Greece (92)	Venezuela (103)
	Mexico (86)	Yugoslavia (128)
	Singapore (91)	

8/ IISI: Projection 85.

Table 3. Basic projection for the years 1985 and 2000 (raw steel base)

Item	1985	2000
Forecast, world production (million tons/year)	1,050	1,750
Targets for developing countries:		
Production (million tons/year)	151	530
Share of production (per cent)	14	30
Per capita production (kg/year)	45	115
Self sufficiency (per cent)	72	100

2. Measures to be taken at national and international levels

In view of the steel production capacity that is under construction and planned in developed and developing countries alike, the following steps could be taken by Governments and the steel industry in those countries in order to achieve steel production targets for 1985 and subsequent years up to 2000:

(a) Developing countries might draw up long-term comprehensive national plans for the development of their iron and steel industries commensurate with their needs and capabilities and integrated with the development of other industrial sectors. They might set up their own national targets for steel production, based on their conditions and resources of technology and finance, in accordance with the recommendations of the Lima Conference. Some developing countries have already drawn up such plans, which include targets up to the year 2000;

(b) Developing countries could advantageously co-operate closely with the developed countries in order to mobilize and supplement their resources of technology and finance, manpower training and business management; the developed countries can lend a powerful hand in these fields to the developing world;

(c) In drafting and implementing their steel plans, the developing countries could take into account very carefully a variety of basic facts and factors drawn from the experience gained so far by other developing countries in expanding their steel capacities. The developing countries could, for example, set up joint platforms for action amongst themselves and seek to pool their resources (raw materials, technology, finances, training etc.) with the sole objective of expanding their steel industry on a sound technical and economic basis;

(d) The Governments of the developing countries, and their private and public sector enterprises, might consider entering into joint ventures amongst themselves and with other countries;

(e) The Governments of the developing countries may consider providing aid for the expansion of the steel industry through assistance in: land acquisition, power and water resources and tariffs, infrastructure facilities (including townships and services), tax exemptions on capital goods, and capital incentives.

Considering the vast economic and industrial gaps between the developed and developing countries, it is essential for them to join hands on technology and finance as part of a new economic order. The developed countries, which are faced or will be faced with ecological deterioration and depletion of their natural resources, will come or are coming to the doors of the developing countries to secure and supplement their massive needs for raw materials and energy resources. Co-operation between the two has therefore to be promoted at all levels in order to achieve global steel targets over the next quarter of a century.

The interdependence and solution of these problems thus require negotiations and agreements on a new set of international economic relations based on the principles of mutual understanding and co-operation.

The developing countries also need to promote among themselves regional and joint plans of action for the interchange of raw materials and steel products on a trade or barter basis (bi- and multilateral), particularly for developing countries that currently have no steel production; means have to be determined and applied to establish steel industries consistent with their population and growing market needs. The steel industry is today no country's monopoly. The least developed countries also have to share the fruits of steel technology and plan its seeding on their home soils through perseverance and with the assistance of their partners in the developing and the developed world. Once the basic objectives are defined and accepted, the course the steel industry has to follow to take root and grow will be less tortuous.

Issue No. 2

RAW MATERIALS AND FUEL: REQUIREMENTS AND AVAILABILITY

Issue 2 (a)

What would be the global requirements for raw materials (including steel scrap) and fuels needed to achieve targets for the production of steel in developed and developing countries in 1985-2000?

How could these requirements be satisfied by supplies from presently available sources and through the development of new ones?

Issue 2 (b)

What steps can be taken/recommended to develop new forms of international co-operation to promote, on an international basis, new mining, beneficiation and more economic use of raw materials and fuels? How far should local processing of raw materials be promoted so as to increase added value for export?

Issue 2 (c)

What measures are needed to promote a mutually advantageous exchange of raw materials and fuels that will enable both developed and developing countries to achieve their steel production targets?

II. BACKGROUND AND SUPPORTING INFORMATION ON ISSUE No. 2

1. Future requirements and resources

World requirements for various raw materials needed during 1973, 1980, 1985 and 2000 to meet the corresponding steel targets are shown in table 4.

Table 5 presents selected data on iron ore, coking coal and hydrocarbon reserves and production.

For iron ore, the situation is quite favourable to the developing countries in terms of high quality ore reserves and production. Figure IV shows the evolution of iron ore production. It can be seen that the share of the developing countries is increasing and is quite substantial in terms of tonnage. In 1973, the developing countries produced 180 million tons of a world total of 490 million tons, and their share was 36 per cent.2/ This illustrates the increasing dependence of the developed countries on the iron resources of the developing countries.

The coking coal reserves of the developing countries are very limited. In general, their volume and quality are insufficient or their exploitation is uneconomic. Non-coking coal reserves are much larger but these coals have so far found only limited application in the iron and steel industry. Their potential for greater use in the future, however, is good.

Despite intense and concerted efforts to cut down coke consumption for iron production during recent decades (see figure V) by technological improvement and innovation, demand for coking coal is creating special problems for the steel industry. The problems arise because total world reserves of coking coal are limited compared with total world reserves of coal, and 90 per cent of the coking coal reserves are found in relatively few places in the world, mainly in developed countries. Developing countries other than China account only for some 2.3 per cent of total world reserves, as shown in table 5.

To help offset the dependence on coking coal, intensive efforts are being made to use non-coking coals more fully: (a) as reductants in direct reduction processes; (b) as "formed coke" in blast furnace iron making; and (c) by coal washing and the blending of semi-coking, non-coking and coking coals for iron smelting. The potential of charcoal as a reductant is also being studied in developing countries since it is a renewable resource and can be the basis for sizeable iron and steel production, as is the case in Brazil (over 3 million tons a year).

Another important input (see figure I) is scrap. No data on scrap are included here, however, because they are difficult to obtain for the developing countries. Most of the scrap used in the iron and steel industry is of two types: internal scrap (generated in iron and steel plants in normal operations) and obsolescence scrap. The supply of internal scrap is a direct function of plant production. Obsolescence scrap is characteristic of highly industrialized countries and is available only in very limited quantities in developing countries, but it can be used for starting a small steel industry, if there is a regular supply of it. Imports of scrap are sometimes possible, but price and availability are uncertain. In the last three years scrap prices fluctuated widely on international and local markets.

2/ All figures in terms of iron contained in ore.

Table 4. Scenarios of world iron and steel industry up to 2000 (data and estimates based on "basic projection")

Item	1973 World (million tons)	1973 Developing countries (million tons)	1973 (%)	1980 World (million tons)	1980 Developing countries (million tons)	1980 (%)	1985 World (million tons)	1985 Developing countries (million tons)	1985 (%)	2000 World (million tons)	2000 Developing countries (million tons)	2000 (%)	Assumptions
1. Iron ore (beneficiated) production	885	262	29	1,007	342	34	1,235	446	37	1,800	914	50	Ore/raw iron: 1973 1.89; 1980 1.85; 1985 1.85; 2000 1.80
Net export developing countries to developed countries		-153			+196			-220			-243		Share of developing countries in production (%): 29; 34; 37; 50
2. Coking coal production	605	28	5	680	37	8	580	47	9	640	75	17	Coke/coking coal = 0.75 Use of non-coking coal: 1980 = 5%; 1985 = 10%; 2000 = 25% 50% of developing countries' consumption is to be imported from developed countries
Net export developing countries to developed countries		-28			-37			-47			-75		
3. Coke production	385	20	11	385	30	15	420	70	19	440	150	34	Coke ratio of world/developing countries 1973: 0.70/0.75; 1980: 0.65/0.70; 1985: 0.60/0.65; 2000: 0.45/0.50
4. Oil and natural gas consumption in the iron and steel industry	95	5	0	88	10	11	165	15	14	193	58	30	Oil and natural gas/raw steel (weight - tie) 1973 = 0.08; 1985 = 0.1; 2000 = 1.1
5. Direct iron production:													Per cent of direct reduction for new capacity: 1973-1985: developing countries 20, developed countries 10; 1985-2000: developing countries 40, developed countries 20
Total	405	58	11	690	90	15	730	137	19	1,100	438	37	
By direct reduction	2	1		17	7	40	34	17	50	288	137	70	
6. Scrap (in-plant and purchase) consumption	305	75	6	400	38	7	565	45	9	885	186	20	World scrap/raw steel = 0.40 Developing countries: 1973 = 0.27; 1985 = 0.3; 2000 = 0.35
7. Raw steel production	685	35	0	800	140	11	1,050	154	14	1,750	530	30	
Net export developing countries to developed countries		-35			-45			-60			0		
8. Finished steel production	586 (kg)	52	9	725 (kg)	98	13	886 (kg)	139	16	1,486 (kg)	450	30	Finished steel/raw steel = 0.8 (1973) - 0.85 (2000) 30% of imports by developing countries are semis
9. Per capita steel production	182	21		205	38		224	45		290	116		In terms of raw steel
Developed countries		562			637			692			820		
10. Per capita steel consumption	169	32		205	47		224	62		290	116		
Developed countries		531			601			645			820		
11. Population (billion)	3.82	2.67	70	4.39	3.07	71	4.69	3.39	72	6.86	4.56	75	Annual growth rate: Developing countries = 2%; developed countries = 1%
Developed countries		1.15			1.23			1.30			1.50		

Table 5. Production and resources of raw materials by region, 1973

Region	Iron ore (million tons)		Coal (million tons)		Coking coal (million tons)	Crude petroleum (million tons)		Natural gas (billion cu m)	
	Production (Fe)	Resource (ore)	Production	Resource	Resource	Production	Reserve	Production	Reserve
	------ Quantity ------								
Developing	176	196,000	573	1,148,000	245,000	1,740	59,000	113	28,500
Sub-Sahelian Africa	37.2	22,600	5	14,500	1,000	120	2,950	0.4	1,750
Arab countries	2.6	4,780	1	140	0	921	38,400	29.6	11,900
Latin America	68.6	99,000	12	35,600	6,000	265	4,050	47.0	2,360
South Asia	22.5	31,000	80	83,100	14,200	300	9,430	27.7	11,300
South-East Asia	1.7	5,080	3	1,600	500	83	2,120	5.5	1,070
East Asia	43.7	33,150	472	1,013,000	223,300	50	2,030	2.8	165
Developed	315	586,000	1,633	7,002,000	683,000	1,030	15,300	1,163	41,900
Western Europe	54.8	31,900	289	402,500	136,500	23	2,390	145	4,670
Eastern Europe	121.1	306,000	657	4,052,000	244,500	448	6,700	283	20,100
North America	83.9	225,800	547	2,383,000	273,000	540	6,020	728	16,100
Oceania	47.2	16,700	55	112,500	6,000	17	230	4	990
Japan	0.6	1,500	22	7,400	4,000	1	4	3	15
South Africa	6.9	4,200	62	44,300	19,000	-	-	-	-
World	491	782,000	2,206	8,150,000	928,000	2,770	74,300	1,276	70,400
	------ Percentage ------								
Developing	35.8	25.0	26.0	14.1	26.4	62.8	79.4	8.9	40.5
Sub-Sahelian Africa	7.6	2.9	0.2	0.2	0.1	4.3	4.0	0.0	2.5
Arab countries	0.5	0.6	0.0	0.0	0.0	33.2	51.7	2.3	16.9
Latin America	14.0	12.7	0.5	0.4	0.6	9.6	5.5	3.7	3.3
South Asia	4.6	4.0	3.6	1.0	1.5	10.8	12.7	2.2	16.1
South East Asia	0.3	0.6	0.1	0.0	0.1	3.0	2.9	0.4	1.5
East Asia	8.9	4.2	21.4	12.4	24.1	1.8	2.7	2.2	0.2
Developed	64.2	74.9	74.0	85.9	73.6	37.1	20.6	91.1	59.5
Western Europe	11.1	4.1	13.1	4.9	14.7	0.8	3.2	11.4	6.6
Eastern Europe	24.7	39.1	29.8	49.7	26.3	16.2	9.0	22.1	29.6
North America	17.1	28.9	24.8	29.2	29.4	19.5	8.1	57.1	22.9
Oceania	9.6	2.1	2.5	1.4	0.6	0.6	0.3	0.3	1.4
Japan	0.1	0.2	1.0	0.1	0.4	0.0	0.0	0.2	0.0
South Africa	1.4	0.5	2.8	0.5	2.0	0.0	0.0	0.0	0.0

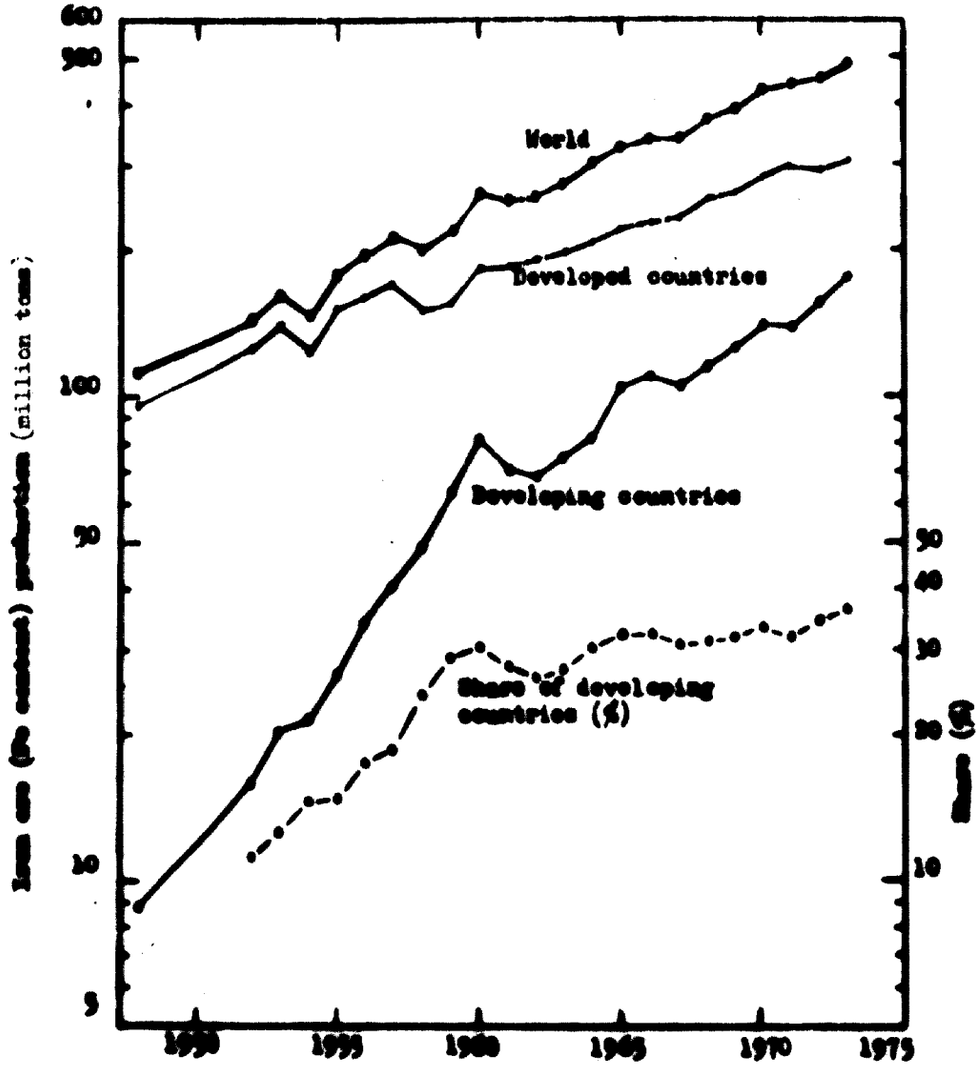

Figure IV. Recent evolution of iron ore production (Fe content)

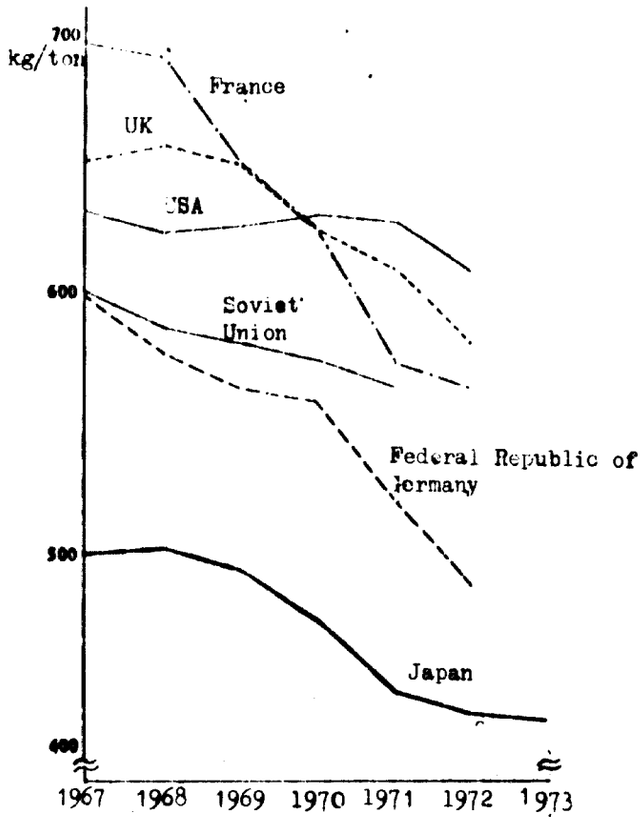

Figure V. Coke ratio by country, 1967-1973

2. New trends and opportunities

Considering the huge quantities involved and the limited number of sources, the supply of raw materials for the world's iron and steel industry will become a critical factor in the next 25 years. Mining, beneficiation installations and transportation (particularly ports and shipping) will have to be developed on an unprecedented scale.

(a) Iron ore

World consumption of iron ore may reach 1,900 million tons by 2000 - more than twice the present mining capacity. Since the development of new large mines takes five to ten years and requires large investments for infrastructure, mine equipment and installations for ore processing, it is clear that this problem alone would merit close study and international co-operation. It is likely that the dependence of the world iron and steel industry on developing countries for supplies of iron ore will increase owing to the definite trend towards the use of high grade ore, sinter, or pellets. Traditional sources of low-grade iron ore are playing an increasingly secondary role because of exhaustion or the higher production costs associated with the use of such ores. The fast development of large-scale transoceanic ore shipping in the recent past has given the developing countries access to new sources of better iron ores, while providing the developing countries with a new source of revenue.

Present trends may be summarized as follows:

A preference for higher grade ores

An increasing use of beneficiated ore, especially pellets

An increasing share of developing countries in the international market

Increasing reliance on large-scale transoceanic shipping and specialized ore ports

Increasing control by developing countries over their own ore production

Increasing efforts to establish local processing; to obtain greater value added; and export pellets, pre-reduced ore (including "sponge iron"), "semis" (billets, slabs, blooms) etc.

The magnitude of the task of expanding iron ore production to the levels indicated above can be gauged by the following estimates:

It will be necessary to develop the equivalent of 50 new mines each producing 20 million tons a year

Transoceanic transportation may involve, by 2000, the equivalent of 1,000 ships each of 100,000 tons capacity.

(b) Reductants

It is more appropriate, when discussing the problems of the world iron and steel industry, to talk in terms of the supply of reductants rather than in terms of energy. This is because the first essential step for the operation and expansion of the iron and steel industry is the reduction of iron oxides by reaction with reductants. The principal reductants, which may be used pure or in mixtures, are carbon, carbon monoxide and hydrogen. While the problem of energy supply can be solved by other means (hydroelectric generation, nuclear power, solar energy etc.) there is no substitute for these three agents for the reduction of iron oxides.

Energy (as heat or electricity) is also necessary for reduction, steel-making and rolling, and renewed efforts must be made to decrease the energy requirements of iron and steel plants, but the principal problem is that of the reductants.

The main reductant used in the iron and steel industry today is coke produced from mixtures of coking coals. The tight supply and increasing price of coking coal are likely to continue in the future because reserves are mainly located in developed countries and there are difficulties in expanding mining. The critical problem for the iron and steel industry, especially in developing countries, is therefore to decrease dependence on coke (and on the blast furnace) and develop the use of non-coking coals, liquid hydrocarbons, natural gas and, when feasible, charcoal. The possible competitors to the coke-operated blast furnace are the so-called "direct reduction"[10/] processes and the charcoal-operated blast furnace.

Accordingly, most efforts to decrease dependence on coke have relied and will continue to rely mainly on the following measures:

(i) The reduction of coke consumption in conventional blast furnaces by careful control of the operation; charge preparation; use of high-grade ores (or sinter or pellets); injection of carbon-rich solids, hydrocarbons or oxygen at tuyere level; increased use of non-coking coals (mixed with coking coals);

(ii) The development and application of appropriate DR processes, according to local conditions, and raw materials and reductants available (hydrocarbons or non-coking coals);

(iii) Where possible, the use of charcoal-operated blast furnaces.

10/ Often abbreviated as DR.

3. National and international efforts required

Special attention should be paid to making the most economical use of raw materials, including the reductants and energy sources required by the expanding steel industry described above, and also to the local processing of raw materials in developing countries and the mutually advantageous exchange of raw materials between developing and developed countries.

Local processing of raw materials such as iron ore should be carefully considered in order to:

(a) Make optimum economic use of the metallic iron value in the ore for iron and steel production at home;

(b) Export an added value product;

(c) Reduce domestic iron and steel production costs;

(d) Obtain greater foreign exchange earnings as a consequence of (a) and (b).

The most advantageous forms of local processing of iron ore might be pelletization of ore fines and pre-reduction of the pellets to highly metallized sponge.

Pelletization of ore fines to produce high-grade oxide pellets is now universally accepted for iron and sponge production because of the high iron content, uniform size, strength and optimum reducibility of the pellets. Pellets can also withstand long distance rail and ocean transport.

International trade in natural lumpy iron ores and fines and pellets has been increasing steadily in step with world iron- and steel-making capacity. Although pellet production started only in 1950, it now accounts for over one fifth of total iron-ore use. There has been a phenomenal rise in the output of pellets from about 70 million tons in the 1960s to about 175 million tons in 1974.

Measures must be taken to ensure a mutually advantageous exchange of raw materials and fuels through equitable prices, so that developed and developing countries alike can achieve their steel production targets. These subjects have come into the limelight only recently. Notwithstanding considerations of cost and price, however, the exchange of raw materials and fuels (energy) should be promoted on a regional (bilateral) and interregional (multilateral) basis through trade and barter between developing and developed countries and between the developing countries themselves.

Issue No. 3

TECHNOLOGICAL ALTERNATIVES

Issue 3 (a)

What measures should be taken for the promotion of techno-economic appraisal and practical evaluation for selection of the most appropriate and proven technological process routes by the developing countries?

Issue 3 (b)

What measures should be taken to ensure the development and adaptation of alternative and applicable technologies for steel production to achieve the required growth of production capacities in developing countries, in particular countries currently having little or no steel production?

Issue 3 (c)

What are the relevant criteria for establishing a steel industry under the conditions existing in developing countries, bearing in mind the economies of scale?

Issue 3 (d)

What are the main parameters for selecting the location of the steel industry in the developing countries, taking into account inter alia (a) the experience of both developed and developing countries; (b) technological alternatives (process routes); and (c) the potential for regional industrial co-operation in the iron and steel industry?

III. BACKGROUND AND SUPPORTING INFORMATION ON ISSUE No. 3

1. Alternatives available

The iron and steel plants now in successful operation in developed and developing countries for production of plain carbon steels differ greatly in size and the processes they use. Many different raw materials and products (and by-products) are processed or produced, using a variety of equipment, at levels from over 10 million tons a year to as low as 20,000 tons a year.

The range of possibilities includes, for example:

Iron ores: low grade oolithic ores with an iron content as low as 26-28 per cent and high phosphorus; hematites with over 60 per cent iron content; taconites and itabirites needing ore dressing

Iron-containing materials for reduction to iron: screened ores, sinter, pellets

High-iron-content materials for steel making: scrap, pre-reduced ores, sponge iron, pig iron (liquid or solid)

Reductants: coke, non-coking coals, charcoal, hydrocarbons (liquid or gaseous), hydrogen (for special iron powder production)

Reduction furnaces: coke blast furnace, charcoal blast furnace, electric reduction furnace, rotary kilns of various types, vertical retorts of various types, fluidised bed units

Steel making furnaces: oxygen converter, open hearth, electric arc furnace, induction furnace, Thomas and Bessemer converters, special furnaces

Ingot casting: conventional top- and bottom-fed ingot molds; continuous casting (various types)

Rolling: a wide variety of equipment is available to roll all types of plate, sheet, sections, bars, rod and tubes. They vary greatly in size, degree of automation, principle of operation, and output.

The selection of process and equipment best fitted to local conditions (raw materials availability, reductants, energy, market situation, infrastructure, related industries, economic situation etc.) is of vital importance for the success of newly installed steelworks. Table 6 indicates various alternative process routes which are in use today. It also indicates the normal ranges for capacity, number of employees, required construction period and cost. These figures vary quite widely depending on local conditions and should be treated as only a rough indication of the applicability of the various process routes.

Table 6. Technological alternatives

Type	Route (Material ——— Process ——— Product)	Application	Capacity of works (1,000 tons/year)	Number of employees (persons) (rough estimates)	Period of construct. (years)	Capital investment (million $)
I a1	Billet ——— Bar/section mill ——— Bars, light sections	Countries with very low steel consumption and without any significant raw materials. Countries supplying material often supply finance and technology	40 (10/100)	200	2	5
I a2	Cold coil/sheet – Coating line ——— Galvanized sheets, tin plates					
I a3	Hot coil ——— Tube/pipe machine ——— Tubes, pipes					
I b1	Hot coil ——— Cold rolling mill — Coating line ——— Flats	There are very few countries using those types today, but may become very important for regional and sub-regional co-operation in connexion with types IV b1 and b3	500 (100/1,000)	1,200	2-3	75
I b2	Bloom ——— Billet/bar/section mill ——— Non-flats					
I b3	Slab ——— Hot rolling mill — Cold rolling mill — Coating line — Flats					
II	Scrap / Sponge iron / Cold pig – EF – Ingot / CC – Rolling mill ——— Mainly non-flats	Most common in developing countries. Availability of scrap at reasonable prices is most important. World wide spread of DR pellets may greatly contribute to the development of this type	100 (20/400)	800	2	25
III a	Charcoal / Ore – Charcoal BF ——— Foundry pig iron	Highly recommended for those countries which have forest resources and are going to initiate steel industries	10 (5/40)	50	2	1
III b	Charcoal / Ore – Charcoal BF ——— LD ——— Ingot / CC ——— Rolling mill ——— Mainly non-flats	Countries with forest resources may become self-sufficient in steel by using this type with relatively low investment	200 (150/400)	2,000	2-3	100
III c	Non-coking coal / Ore – Electric reduct. furnace — LD — Ingot / CC — Rolling mill ——— Non-flats and flats	Countries with abundant cheap electricity with low cost but good coking coal may advantageously employ this type	200 (150/1,000)	2,000	2-3	100
IV b1	Coke / Ore – BF ——— LD ——— Ingot / CC ——— Rolling mill ——— Non-flats and flats	Applicable for countries with a large market and relatively high level of industrialization	1,000 (300/10,000)	6,000	5-6	400
IV b2	Gas (or coal) / High grade ore – DR ——— EF ——— Ingot / CC ——— Rolling mill ——— Non-flats and flats	Gas-rich countries can make most advantageous use of this type. Flexibility in scale of works is also advantageous for developing countries	500 (150/1,500)	1,000	3-4	250
IV b1	Coke / Ore – BF ——— LD ——— CC ——— Slabs, blooms, billets	Ore-rich countries may have this type with long-term agreements for the export of semis	2,000 (2,000/10,000)	4,000	5-6	1,000
IV b2	Gas (or coal) / High grade ore – DR ——— DR pellets	Gas-rich countries may contribute to the development of type II in many developing countries by providing a stable supply of pellets	1,000 (1,000/5,000)	1,500	3-4	150
IV b3	Gas (or coal) / High grade ore – DR ——— EF ——— CC ——— Slabs, blooms, billets	Gas-rich countries may have this type with long-term agreements for the export of semis	1,000 (1,000/3,000)	2,500	4-5	400

Abbreviations: BF = blast furnace; CC = continuous casting; DR = direct reduction; EF = electric furnace; LD = Linz-Donawitz process.

The table is self explanatory, but the following points seem to be worthy of attention:

There is a wide variety of processes, equipment and scale of operations to choose from

Small semi-integrated (steelmaking plus rolling) plants can be operated on the basis of scrap at a scale as low as 20,000 tons a year

Pig iron can be produced at a scale as low as 5,000 tons a year (for foundries)

Small integrated plants based on the charcoal blast furnace can be very successfully operated at a scale as low as 100,000 tons a year (and even lower, under special conditions)

Certain direct reduction processes can be the basis for fully integrated plants (ore-to-product) at scales as low as 100,000-150,000 tons a year. Production of sponge for sale is also an interesting option for certain developing countries

In certain cases, production is limited to semi-finished products (slab, bloom, billet) which are then transported for processing elsewhere in the country or exported. Certain developing countries seem to have good potential for this type of operation

It should be noted that for some of the process route options outlined in table 6, certain developing countries are in a better position to assist other developing countries better than developed countries would be. This is particularly true for certain direct reduction processes and for charcoal-based iron and steel production.

When considering the application of a very new technology, care must be taken to relegate unproven processes to a stage where they can first be fully technically and economically proved and accepted; this is of specific importance to developing countries. Applicable technologies must be developed and adapted for steel production in developing countries, particularly countries with practically no steel production. Many developing countries have paid a heavy price for applying unproved sponge-production technology based on solid reductants.

2. Economies of scale

Considerations of economies of scale should not discourage developing countries from setting up iron and steel production facilities. As the size of a steel plant increases and approaches 500,000 to 1 million tons a year, energy and materials costs per ton level out, and capital cost per annual ton capacity decreases. At higher capacities rising to 5 and 10 million tons a year, the capital cost per annual ton capacity decreases further. In the developing countries and the least developed countries, however, the principal determinants of plant size should be domestic market needs and raw material resources; this is specifically so for scrap-based mini steel plants and mills. In many developing and developed countries, integrated multi-million ton steel complexes operate just as well as the large number of mini steel plants in Brazil, India, the United States, and elsewhere. The mini plants (scrap based) usually serve local markets. They rely on local scrap collection, not all of which can be economically transported to large steel complexes. Thus, in such cases, the economic unit can be quite small. Largely because of the transport cost advantages (rail and road), mini plants in Europe, Brazil, India, the United States, and many other countries have demonstrated their economic viability.

3. Locational factors

If raw materials are not available locally in a country and have to be imported, a coastal tide-water location is an essential requirement for a steel plant, as is amply demonstrated by the coastal steel plants in Japan. Where local iron ore and fuel resources are available inland, as in India, the optimum location of the steel plant is dictated by transportation costs, market areas, and availability of water (rivers etc.) and services.

The principal factors governing the location of an integrated steel complex include:

(a) Availability, and transport and assembly costs of raw materials (iron ore, coal etc.);

(b) Principal market areas;

(c) Township and infrastructure needs;

(d) Availability of water supplies and other services;

(e) Manpower supplies and labour costs;

(f) Environmental considerations and constraints.

This list could be further elaborated, depending on whether the steel plant is to be an integrated, semi-integrated or mini one.

Proximity to a gas field is a primary consideration for the location of a direct reduction sponge plant. Modern slurry iron-ore concentrate transport systems favour coastal integrated steel plants.

Issue No. 4

KNOW-HOW AND HUMAN RESOURCES

Issue 4 (a)

What were the main difficulties in the setting up of technical consultancy services for the development of iron and steel industries in the developing countries in the past? How can the experience and co-operation of developed countries be utilized for the mutual benefit of developed and developing countries?

Issue 4 (b)

What has been the experience of the developing countries in the use of technical consultancy services provided by the developed countries in the establishment/expansion of their steel industry?

Issue 4 (c)

What measures can be adopted to promote the development of technical consultancy services in the developing countries to the extent consistent with their national plans, objectives and capabilities?

In particular to what extent can the steel projects which are under construction and planned in developing countries promote, on a national or regional basis, the development of technical consultancy services in these countries?

Issue 4 (d)

To what extent have the developing countries benefited from the training provided by the developed countries and what has been their experience in these fields?

Issue 4 (e)

What steps can be recommended/taken to promote the training of personnel including business management for the steel industry of the developing countries by international organisations agencies?

Issue 4 (f)

What measures can be taken by the developing countries themselves for providing training facilities for the growth of their iron and steel industry?

IV. BACKGROUND AND SUPPORTING INFORMATION ON ISSUE NO. 4

1. The role of technical consultancy services

Know-how and technology may make the difference between success and failure in the expansion of such a capital-intensive sector as iron and steel. Although the basic science and technologies used today in the iron and steel industry have been available for a long time, the sector is very sensitive to small improvements obtained through long term research and development or a slow accumulation of operating experience.[11/]

The main areas where know-how is essential in the iron and steel industry are general planning and feasibility evaluation, plant design and engineering, equipment design and manufacture, plant construction, process and product development and control, and management of operations. In all of these areas, the developed countries have today a decided advantage, and the expansion of the world's iron and steel industry will depend to a great extent on their collaboration with the developing countries in know-how and technology arrangements.

Figure V illustrates the many steps required between planning and operation and gives a rough estimate of manpower requirements for the construction of large-scale integrated steelworks. Selection of the best site, most appropriate design of plant, most economical purchase of equipment and structures, shortening of construction period and shortest possible start-up period are the main criteria for the planning and engineering of new steelworks.

As indicated in figure VI, the establishment of a steelworks takes a long time and requires a large number of trained personnel. Only long experience and accumulation of know-how and technology can develop the planning and engineering capability needed.

At present in the iron and steel sector, the developing countries are almost totally dependent on the developed countries for the know-how and technology required for sectional planning; plant design, engineering and construction; plant operations and management; and process and product engineering. This dependence could be measured in terms of the outlay for technical services (feasibility studies, sectoral planning, engineering and design, start-up and construction) but no statistics exist for this software trade. It is estimated, however, that it accounts for some 5 to 8 per cent of total investment in the sector. On the basis of the growth projected for the iron and steel sector of the developing countries, some 95 million tons capacity will have to be established in the decade 1976-1985, involving an investment of the order of $85 billion. This would correspond to about $5 billion of technical services required by developing countries. Since some of the developing countries have a substantial capability in this broad area (Argentina, Brasil, China, India, Mexico, and others) it is estimated that about 80 per cent of the amount mentioned (i.e. $4 billion over the decade) will have to be spent abroad. Apart from the fact that the outlays in foreign currency for specialised services imported from developed countries will be substantial in themselves, there is a more important consideration to be kept in mind: the decisions made or implied in the preparation of feasibility studies or

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11/ The iron and steel industry has never had a technological breakthrough comparable to the transistor, for example. The oxygen converter, which revolutionised the economics of the industry, was proposed by Bessemer a century ago.

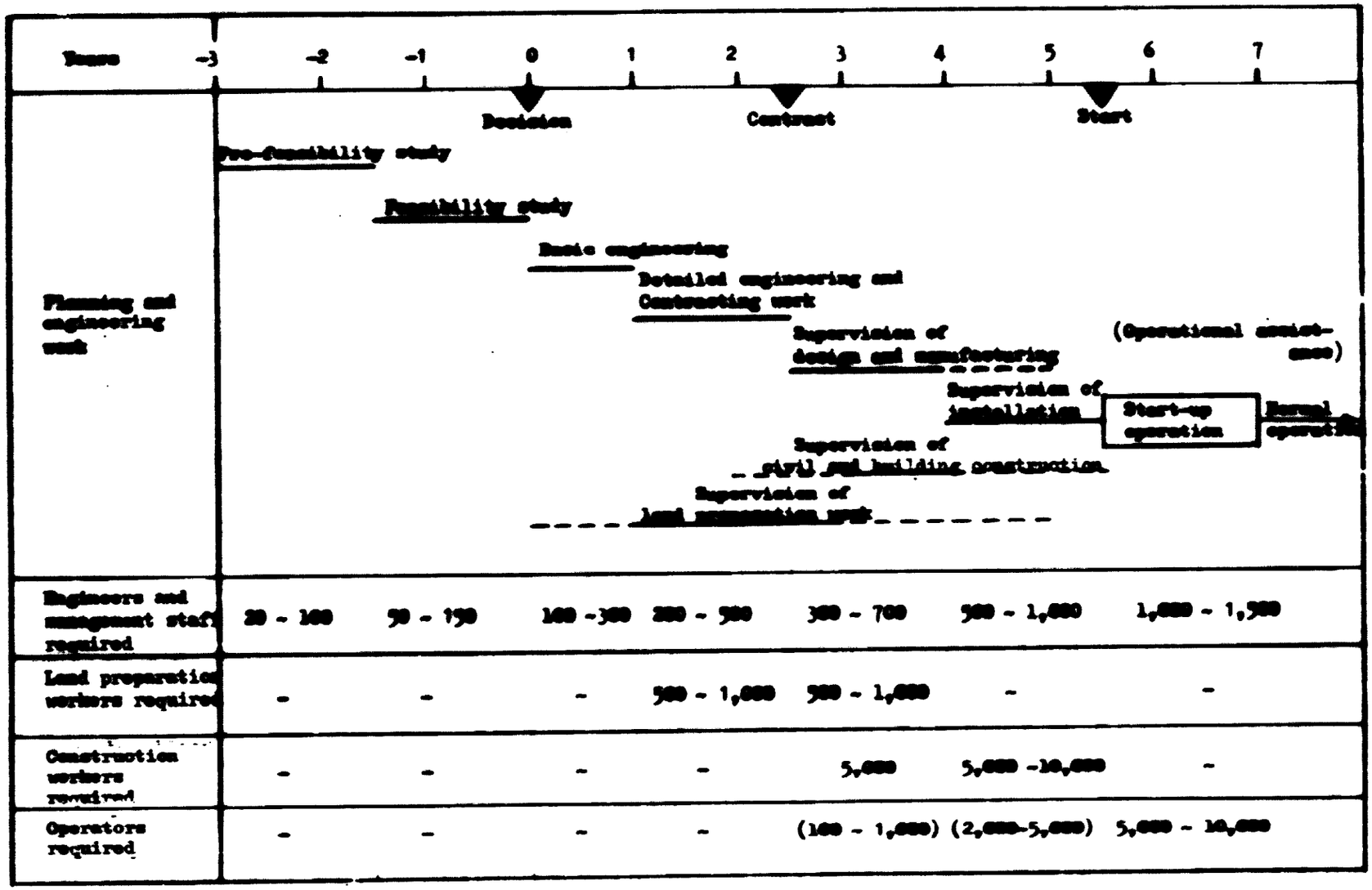


Figure VI. Engineering work and manpower requirement for the construction of 1-2 million tons per year integrated steelworks (rough estimates). (These figures are indicative of the relative manpower requirements but they vary widely from country to country, regardless of degree of development.)

in the engineering of new plant installations have specific implications for the developing countries and to a large extent control the choice of process and equipment. As a result, developing countries frequently find themselves burdened with processes and industrial installations which are not really the best suited to their conditions and needs. Furthermore, the dependence on imported know-how restricts the development of local capability, especially technical services and capital-goods production.

Besides being purchasers of explicit know-how (the technical services mentioned above) developing countries are also importers of large amounts of implicit know-how "built into" the equipment they buy abroad for their iron and steel plants. It is estimated that roughly 20 per cent of the cost of the plant equipment purchased abroad represents payments for know-how (designers, mechanical engineers, skilled technicians and workers etc.). Thus, the true cost of know-how, in terms of both total requirements and imported know-how, would be much higher than the figures quoted for technical services alone.

2. Experience of the developing countries

Developing countries such as Brazil and India have endeavoured to build up their own technical consultancy services in the public and private sectors with valuable results. The recommendations made by a planning body in one developing country[12/] with the aim of speeding-up attainment of maximum self-reliance in technical consultancy services for industry (including the iron and steel industry) cover:

(1) Routing of imports of process know-how and equipment design through consulting/process engineers so as to avoid duplicating imports of know-how;

(2) Allowing the importation of new and improved processes and technologies for the manufacture of the same product only when there is a demonstrable advantage in doing so;

(3) Allowing the importation of know-how and process designs as far as possible only on a non-exclusive basis;

(4) Avoiding the importation of package deals and turn-key jobs;

(5) Encouraging the establishment of proper liaison between research laboratories, equipment and product manufactures, and consultancy and process design organizations as a means of hastening the commercial utilization of the results of indigenous research, design and development work;

(6) Avoiding expenditure of foreign exchange on feasibility studies;

(7) Ensuring that the main work of compiling data and designing plant and equipment is done within the country, if necessary with assistance from foreign experts.

The experience of developing countries in the use of technical consultancy services provided by the developed countries in the establishment or expansion of their steel industries has been of a varied nature. In some cases, it has been highly satisfactory, but in other cases, it has been quite unsatisfactory. The reasons for dissatisfaction include:

12/ Journal of Scientific and Industrial Research, vol. 29 (December 1970), pp. 537-538.

1. Improper matching of steel-plant constituent units (coke ovens, blast furnaces, steel-making, the rolling mills and finishing departments);

2. The recommendation of technological processes that were unproved, and recommendations aimed at boosting sales of equipment;

3. Unsuitable plant locations, layout, and services;

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

5. Technical and economic studies that lack depth and detailed analyses of capital equipment and investment costs (local currency and foreign exchange components);

6. Underestimation of operational and production costs.

In the developing countries, the choice of technological processes and economic considerations are often based on non-technical factors because the selection of process technology and the related plant equipment are inevitably linked with the particular iron-and steel-making capital equipment supplied by the country providing the technical and/or financial aid. The choice of process and the operational flowsheet therefore depend on 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 selected may not be the best technically but it could still enable a country to meet recurring demands for capital spares and trained technical personnel.

The application of newly-developed process is not necessarily automatic or axiomatic in a developing country. Any new process has to be tested over a substantial period before it can be recommended for application elsewhere. Many new processes could fall by the way-side in a developing country because, for example, instrumentation, automation, and mechanical control have not been sufficiently developed locally. Apart from capital outlay and foreign exchange resources, factors that must be taken into account would include the availability of raw materials, steel scrap, and fuel.

3. National efforts and international co-operation required

It is vital for the developing countries, individually or as a group, to develop to the maximum their local capabilities for the planning, engineering, design, construction and start-up of new iron and steel capacity. This will require the establishment of local consulting and engineering firms or organizations, which may be private or government-sponsored. A variety of such firms would be needed in the larger developing countries, each with a certain degree of specialization in the various services required. In the smaller developing countries, or in those where industrialization is just beginning, a government organization might be put in charge of developing local sources of iron and steel know-how. It should be emphasized that know-how is needed to evaluate, select and purchase know-how from abroad. It is also essential to have local capability to evaluate and reach decisions on planning and investment. Apart from the incentives and support which the Governments of developing countries may wish to offer to stimulate the establishment of specialized technical services, it is clear that there is ample room for constructive international co-operation in this area.

Developing countries should lay special stress on the development of local know-how capability, beginning with the civil engineering work, followed by auxiliary facilities and, finally, the planning and engineering of the main plant. Steelworks always require modernization and plant operators easily adapt to modernization planning. Some of the developing countries already ask foreign engineering companies to use domestic engineering capability as much as possible, so as to transfer know-how and technology to local personnel. Steelworks built under "turn-key" contracts with foreign enterprises sometimes run into serious operating difficulties. The maximum use of domestic human resources and capability, from the stage of planning and engineering, is the key factor for successful operation.

4. Manpower and training

Some of the steelworks of the developing countries are operating at present at only a part of their capacity, in spite of high demand for iron and steel products on the local market. The main reason for this is usually a lack of trained managerial and technical personnel. Since under-utilization of equipment is the main cause of increased costs in a capital-intensive industry such as the steel industry, training of managerial and technical personnel is essential.

The number of personnel directly required for operation varies largely according to location and plant size. For the developing countries the number may reach 6,000 to 10,000 for a 1 million ton per year integrated works with a productivity of the order of 100 to 170 tons per man-year, which is low. For a production of 530 million tons in 2000, some 3 to 5 million workers would be necessary. About 20 per cent (0.6 to 1 million) of these would have to be well-trained management and technical personnel and another 30 per cent at least skilled workers. The figures are indicative of the order of magnitude of the problem to be tackled.

It should be noted that it is necessary to train a considerable number of workers well before the start-up of the works and also for a long time afterwards. Educational and training facilities are of the highest importance for smooth operation and must be a permanent feature of plant activities.

Particular attention must be given to the training of maintenance workers and to the establishment of a maintenance system that is best fitted to local conditions. A stoppage in one department of an integrated works often means a stoppage of the whole works. Without a well-established maintenance system it is impossible to maintain production at a steady and efficient pace.

In the ultimate analysis, the critical factor for the successful establishment and operation of iron and steel plants is the availability of local personnel of the highest calibre. The development of full local capability for planning, engineering, construction and operation is directly related to education and training; it requires and justifies special national and international efforts.

Developing countries can greatly assist each other in the training of manpower for the steel industry; there are several notable examples of such assistance. The training thus provided by a developing country is well suited to the recipient country's plant needs and operational and maintenance requirements. Training provided by an advanced country in sophisticated instrumentation, automation, automatic control systems, and computerized operations may not always be as

useful unless such specialized training is specifically needed by a developing country. In some least-developed and small steel-producing countries, assistance is needed in different training areas. Such considerations must be carefully matched.

The developing countries can also assist each other in the field of high-level business management. International organizations (including United Nations agencies) can play and have played useful roles in providing efficient managers and business management to the iron and steel industry in developing countries.

Issue No. 5

POTENTIAL FOR THE MANUFACTURE OF CAPITAL GOODS FOR THE IRON AND STEEL INDUSTRY IN DEVELOPING COUNTRIES

Issue 5 (a)

What has been the experience of developing countries so far in importing the capital goods required for their steel industry?

Issue 5 (b)

What are the main difficulties delaying the growth, in the developing countries, of the manufacture of capital goods for the establishment/expansion of their steel industry?

Issue 5 (c)

What steps should be taken by the developing and developed countries to promote the manufacture of capital goods in the former and to reduce their need for imports of equipment for the iron and steel industry?

Issue 5 (d)

What measures should be taken to ensure that the already planned steel projects and installed capacity in developing countries will lay the basis for developing on a national or regional basis the manufacture of capital goods?

V. BACKGROUND AND SUPPORTING INFORMATION FOR ISSUE NO. 5

1. The need for the manufacture of capital goods in developing countries

The developing countries depend almost entirely at present on the developed countries for the specialised equipment and heavy structures needed to build iron and steel plants. Although China and India have attained a high degree of self-sufficiency, all the other developing countries depend on the developed countries to supply 70 to 100 per cent of the hardware needed for the expansion of the steel sector.

In the next 25 years the developing countries will constitute a market for capital goods (equipment and structures) of roughly the same size as the market for the same goods in all the developed countries. The capacity to be installed in the developing countries in the decade from 1976 to 1985 alone will be of the order of 95 million tons which represent a capital goods market equivalent to two to four times the total capacity installed in the largest producer

countries of Western Europe. This large new market for capital goods certainly justifies the expansion or establishment of facilities for their production in the developing countries themselves.

The additional facilities would be justified by savings in foreign exchange, a greater degree of self-sufficiency and self-reliance, the acquisition of critical technological capabilities, the possibility of designing and building equipment appropriate to local conditions, and the creation of specialized jobs and opportunities for advancement for local workers.

It is recognized that the production of capital goods requires highly-skilled management and technical personnel. There is no reason to believe, however, that this is not possible in the developing countries, and there is indeed no alternative, because the developing countries will be unable to expand their iron and steel industries to meet the Lima target unless they have their own sources of heavy capital goods to cover at least 70 to 80 per cent of their total needs. Since other sectors of the industry and infrastructure also require heavy capital goods, it is certain that the market in the developing countries more than justifies the further installation of local production capacity.

The steel industry is the largest consumer of capital goods. In order to construct a 1 million ton per year steel works some 200,000 tons of equipment and heavy structural materials have to be used. This means that in order to reach the target previously suggested for developing countries, roughly 100 million tons of heavy capital goods equipped with sophisticated instrumentation will have to be supplied within 25 years. If the requirements for modernization and maintenance of steel plants are taken into account, the figure will increase considerably. Since capital goods are very expensive and world production capacity is limited, the creation of new capacity to produce heavy equipment and structural materials locally is of great importance for developing countries unless such capacity is created. The dependence of the developing countries on the developed countries may reach a level at which it becomes a burden for both sides.

2. Design and manufacture of capital goods

The design and manufacture of capital goods are part of the industrial heavy machinery sector, which consists of a large number of manufacturers operating either as independent engineering firms or parts of complexes. Major steel-making centres in Europe, North America and Japan, and increasingly in such countries as Brazil, China and India, are capable of doing most of the necessary engineering and manufacturing work for themselves and for export.

The weight of the capital plant and machinery is normally one tenth of the installed steel production capacity: 10 million tons of new steel-making facility may require something like 1 million tons of equipment, excluding heavy and light structural materials. A more specific estimate is given in table 7.

Table 7. Estimate of equipment and structural materials requirements

	Plant capacity (million tons)			
	0.5	1.0	2.0	5.0
Gas route plants				
Equipment	45,500	85,500	160,000	
Structurals	20,000	35,000	60,000	
Blast furnace route				
Equipment			220,000	400,000
Structurals			175,000	320,000

Source: M.M. Luther, "Steel production in the Arab world by the year 2000 with particular reference to capital equipment", New Delhi, June 1976, annexures III, IV.

It may be assumed that the average annual requirement of spares is between 2,400 and 3,600 tons per million tons of capacity, depending on the age of equipment and maintenance.[13] In order to determine which domestic spares manufacturing facilities are lacking, an analysis must be made of spare parts according to the raw materials from which they were made (iron castings, steel castings, non-ferrous castings, forgings, structural steel items) and their weight. Particular attention should be given to facilities for the manufacture of medium and heavy spares. In Mexico, for example, medium and heavy spares account for as much as 70 per cent of expenditure on spares, although the quantities involved are small compared with total requirements.

The development of a local spare parts manufacturing capacity is technologically quite simple. Its growth, however, will be affected by such factors as:[14]

Uncertain quality of indigenous supplies

Lack of interest shown by local industries in making custom-made spares for which the likelihood of repeat orders is very limited

Government tariff and customs policy on the import of spares

Local price of manufactured spare parts as compared with c.i.f. price of imported spares

The agreement or disagreement of the steel plant management to risk trying locally manufactured spares in view of the reliability of imported spares from original suppliers

Stipulation by the purchaser, at the time the principal equipment is ordered, that adequate spare parts and drawings must be supplied by the designers and manufacturers

Long delays in the execution of spare-parts orders might also be characteristic of a young industrial venture in this field, owing to such factors as:[15]

Shortage or unavailability of suitable raw materials in the country

Inadequate manufacturing capacity

Lack of technical know-how

Inadequate manufacturing skill

Nevertheless, if spares are not manufactured locally, not only will delays be longer and import bills higher; chances to develop local engineering skills and manufacturing capability will be missed.

Spares may be produced in captive workshops attached to the steel works; and central workshops may also produce important spares and assemblies common to all steel plants (mill spindlers, table frames, rope drums and brake drums for cranes, roll housings).

Further expansion of manufacture design and capital goods requires a well-planned establishment of design and heavy engineering capability and metal working capacities.

3. Forms of developing local steel-plant engineering and production capability

In developing local steel-plant engineering and production capability, priority may initially be given to light- and medium-weight rolling mills and finishing line equipment. Heavy capital equipment in the rolling mills (heavy blooming and slabbing mills, wide hot and cold strip mills) can be considered in subsequent phases of the development of heavy capital-goods manufacturing capacity.

13/ Ch. L. Sengupta, assisted by UNIDO-NAFINSA team, Scope of Manufacture of Steel Plant Equipment in Mexico, Mexico City, May 1976, vol. II.XII-5-6.

14/ Ibid., vol. II.XII-3.

15/ Ibid., vol. II-XII-2-3.

The light- and medium-weight equipment may include billet mills, bar mills, wire rod mills, light structural mills, merchant mills, transfer beds, cooling beds, coilers, shears, and saws. Finishing lines will include such items as straighteners, saws, shears, bundling facilities for structurals, bars and rods. Equipment for cutting and squaring lines for all flat products, and continuous casting machines, could also be acquired.

There are many repetitive items of rolling mill equipment. They include mill stands, cooling beds, roller tables, coilers, coil conveyors, and straightening machines. There may be several hundred of each of some of the components.

There are three main ways to build up a capital steel-plant manufacturing industry:

(a) A design and engineering company can manufacture heavy steel-plant equipment either to imported blue-prints and drawings on payment of appropriate royalties or independently using standard assemblies. Foundries, forge plants and equipment fabrication works within the country can be utilized in the manufacture of lighter equipment. The design and engineering company should have a competent inspection department, a strong engineering team for assembly and commissioning, and possibly a medium-sized assembly shop for trial and checking and, if necessary, rectification;

(b) One or more existing heavy-machine manufacturing companies already making engineering equipment for other industries (chemical, cement etc.) might expand and restructure to meet the requirements of steel plant equipment and machinery manufacture;

(c) A new plant may be set up on a green-field site to manufacture equipment and spare parts.

Heavy engineering, once started, can service several industries such as the chemical and cement industries. In the heavy capital goods sector, an appropriate balance of engineering, production and marketing capabilities can be fully exploited and assessed over longer gestation and operational periods.

4. International co-operation

In importing capital goods for their steel industries, the developing countries have found that the selection of process technology and the related capital equipment are often linked with the particular capital equipment supplied by the country providing the technical and financial aid; the capital equipment may, therefore, not always be the most suitable equipment for the developing country's steel industry. Furthermore, there may be no international tender for capital equipment when it is supplied against the technical and financial aid from an advanced country; the cost of such capital equipment thus tends to be much higher than on the open capital-goods market. Nor has the developing country any control over the cost of capital spares for equipment already supplied, and the over-all costs keep mounting; the costs of spares go on increasing as the plant and equipment get older. There is therefore good reason for the developing countries to design and manufacture capital goods for the steel industry themselves. There are, however, many difficulties involved: there may be no indigenous facilities for the design engineering of capital equipment, there may be no manufacturing facilities for heavy capital equipment, and there may be a lack of finances and technology.

It is therefore vitally important for the developing countries to establish capabilities for the design engineering and manufacturing of capital goods for the steel industry in collaboration with advanced countries. The measures required must be planned and implemented bilaterally or multilaterally, and some developing countries have already made good progress on this. In order to promote domestic capital-goods production capacity, some of the developing countries have been:

(a) Promoting the establishment of companies for the local production of capital goods under joint-venture arrangements;

(b) Requiring foreign suppliers to use a certain percentage of domestic capital goods even if these are considerably more expensive than imported goods.

Issue No. 6

INVESTMENT AND FINANCIAL REQUIREMENTS FOR EXPANSION OF THE WORLD'S IRON AND STEEL INDUSTRY

Issue 6 (a)

What are the estimated requirements in terms of capital and financing for the expansion of the world's iron and steel industry? Which could be the sources and modalities of the financing required?

Issue 6 (b)

Bearing in mind the multiplier effects of the steel industry in the process of industrialisation, what should be the criteria (besides social cost-benefit analysis) for decisions on financing specific industrial projects?

Issue 6 (c)

What has been the actual experience of developing countries in obtaining the needed capital and finances for investment in their iron and steel industry in relation to: bilateral and multilateral loans and long-term financial assistance; private investment; barter, trade, reciprocity arrangements and leasing? For the future growth of the iron and steel industry what is the relative potential of these forms of international financing and co-operation?

Issue 6 (d)

What has been the experience of developing countries with regard to international bidding, "turn-key" contracts (packaged deals), supplier's credit and equity investment, joint ventures and consortia-based agreements and what has been the role of the above practices?

Issue 6 (e)

What steps should the developing countries take to promote local currency financing from internal sources in the field of iron and steel industry?

Issue 6 (f)

What immediate measures could be considered to assist developing countries in the provision of urgent capital financing for setting up/expanding the steel industry based upon mutually acceptable terms, including co-operation amongst developing countries themselves?

VI. BACKGROUND INFORMATION ON ISSUE NO. 6

1. Financial requirements

A few developing countries have adequate means to finance the expansion of their iron and steel industries, but most developing countries will have to rely on external financing to cover much or even most of the huge investment required between now and 2000. Table 8 provides a preliminary estimate of new capacity to be added yearly or five-yearly. In the decade 1976-1985 some 95 million tons of new capacity will have to be built and put into full operation. In addition, further investment will have to be made in installations which will not be productive in the decade. It will therefore be necessary to secure financing for most of the new capacity to be installed and operated in the decade (it is assumed that part of this has already been secured) and for capacity which will still be under construction in 1985. If only the capacity to be installed and operated is considered, the requirement will be of the order of $86 billion. Of this total, a good share will be in national currency to be spent locally. This share could be of the order of 50 per cent for all the developing countries taken together, taking into consideration that some of them can secure locally some of the necessary services, construction materials and equipment. For the part of the investment that will have to be financed in foreign currency, some developing countries can count on their balance of trade surpluses. It is not easy, without further analysis, to calculate the remaining share to be financed by the developed countries, but it could be as high as 20 per cent of total investment requirements (or some $17 billion), or about 45 per cent of all goods and services to be purchased abroad in the period ($17 billion out of a total of $39 billion).

Table 9 presents a rough estimate of needs and capabilities for financing the expansion of the iron and steel industry in developing countries in the future. It is illustrative and intended to indicate orders of magnitude only.

One important problem related to the huge investments required is the profitability of the industry. In order to ensure its growth, the industry must make profits to justify investment for further development. The steel industry, however, is responsible for the stable supply of basic products to the market at low prices. Large fluctuations in the prices of essential materials such as those of recent years should be avoided. Furthermore, the steel industry of the developing countries is weak compared with the giant modern complexes in the developed countries. Because of smaller plants and lower utilization ratio of equipment, this weakness is likely to continue for some time, except for some plants which are exceptionally well located. Efforts should be made to determine the conditions that will ensure the viability and profitability of the iron and steel industries of the developing countries.

2. Increasing investment costs

Figures for capital costs on iron and steel plants cannot be interpreted or compared meaningfully unless the various components of the total capital cost are defined adequately.

Capital costs should normally include costs of plant and equipment, civil works and erection, engineering, pre-operational expenses, and working capital (including interest during construction).

Table 8. Capacity increases, investment and equipment requirements in the developing countries a/, b/
(Rough estimates at constant price assumed for 1976)

Year	Production (million tons)	Capacity (million tons)			Investment ($ billion) a/, c/		Equipment and structure a/, d/ ($ billion)	
		Annual 1/	Increase		Requirement		Requirement	
			5-year	Yearly	5-year	Yearly	5-year	Yearly
1973	55.6							
76	71.4	84.0		7		6		3
77	77.6	91.3		7		7		4
78	84.4	99.3	40	8	36	7	20	4
79	91.7	107.9		9		8		4
1980	99.7	117.3		9		8		5
81	108.4	123.8		9		8		5
82	117.8	134.6		9		9		5
83	128.0	146.3	56	12	50	10	28	5
84	139.2	159.1		13		11		6
1985	151.3	172.9		13		12		7
86	164.5	188.0		15		15		9
87	178.8	204.3		16		16		9
88	194.3	222.1	89	18	85	17	47	9
89	211.2	241.4		19		18		10
1990	229.6	262.4		19		19		10
91	249.6	277.3		19		20		10
92	271.3	301.4		22		21		12
93	294.9	327.7	125	25	119	24	65	13
94	320.5	356.1		28		26		14
1995	348.4	387.1		31		29		16
96	378.8	420.9		33		32		18
97	411.7	457.4		36		34		19
98	447.5	497.2	200	40	190	38	105	21
99	486.5	540.6		44		42		23
2000	528.8	587.6		47		45		24
	TOTAL		510		450		265	

a/ The figures for a given period correspond strictly to the requirements for the actual increase in production during that period. No provision has been made for replacement, modernization and maintenance.

b/ The estimates provide general trends and are based on constant (1976) prices. Factors such as escalation in capital equipment costs, inflation, and devaluation of currencies require separate treatment and are not covered in these estimates. Capital equipment supplies (the cost of which varies by 100 per cent or more depending upon the sources/countries supplying them) are also based on averages.

c/ Estimates based on following assumptions:

(i) Investment includes planning, engineering and know-how fee; equipment (including land preparation) and erecting work; pre-operational and working capital. It does not include infrastructural and ancillary facilities outside battery limit such as external power house, mining, deep-sea port, external rail and road system, township;

(ii) Investment cost per ton of annual production capacity is $1,000 for the new production capacity at a green-field site and $600 for expansion of an existing steel plant;

(iii) These estimates relate to wholly conventional iron and steel production (blast furnace/LD oxygen steel making/steel casting and rolling) for establishing new steel capacity on a green-field site and/or expansion. Steel production based on scrap melting in electric arc furnaces/casting and rolling, including mini steel plants, requires much less capital investment per ton capacity than is shown here and will depend upon such factors as electric furnace size and mill capacities;

(iv) That 75 per cent of new production capacity is created at the green-field sites for the period of 1976-1985, and 85 per cent for 1986-2000.

d/ Estimates based on the assumption that the cost of equipment and structural material is 55 per cent of the total investment.

e/ Estimates based on the assumption that capacity utilization ratios are 85 per cent for the period of 1976-1980, 87.5 per cent for 1981-1990 and 90 per cent for 1991-2000.

Table 9. Foreign currency requirements of developing countries[a/]

Item		Group[b/]								Total	
		Arab countries		Advanced developing countries c/		Centrally planned developing countries d/		Other countries			
		1976–1985	1986–2000	1976–1985	1986–2000	1976–1985	1986–2000	1976–1985	1986–2000	1976–1985	1986–2000
I	Production increase (million tons)	12	47	40	145	25	110	5	80	81	382
II	Capacity increase (million tons)	14	51	47	157	29	119	6	87	95	414
III	Investment total[e/] ($ billion)	13	48.5	42	149	26	113	5.5	83	86	394
	Engineering[f/] (6%)	1	3	2.5	9	1.5	7	0.5	5	5	24
	Equipment and structurals (55%)	7	26.5	23.5	82	14	62	3	46	47	217
	Civil and erecting (29%)	4	14	12	43	7.5	33	1.5	24	25	114
	Others g/ (10%)	1	5	4	15	3	11	0.5	8	8.5	39
IV	External dependence (%)										
	Engineering	95	80	80	50	30	10	95	30		
	Equipment and structurals	95	70	70	30	30	10	95	70		
	Civil and erecting	70	50	20	0	0	0	70	50		
V	Purchase from abroad ($ billion) (foreign currency requirement) h/	9	28.5	21	29	4.5	7	4	48	38.5	112.5
	Engineering	1	2.5	2	4.5	0.5	1	0.5	4	4	12
	Equipment and structurals	7	19	16.5	24.5	4	6	3.0	32	30.5	81.5
	Civil and erecting	1	7	2.5	0	0	0	0.5	12	4	19

a/ Based on uncertain assumptions; so the table should be treated as indicative only.

b/ Very rough grouping according to characteristics of countries.

c/ Argentina, Brazil, India, Mexico and others.

d/ China, Cuba, Democratic People's Republic of Korea and others.

e/ Assumptions made for table 8 (notes a–e) apply to table 9.

f/ Includes from pre-feasibility study to plant operation know-how.

g/ Working capital and pre-operational expenses.

h/ Calculated by multiplying each component of item III by corresponding component of item IV.

In developing countries, integrated steel plants cannot be built for the same capital cost per ton of steel capacity as in Japan, the United States, and developed countries in Europe. Investment costs in developing countries are invariably higher for a variety of reasons.

Capital costs vary from country to country, depending on the status of industrial development, infrastructure facilities and services available; they therefore hardly lend themselves to any absolute comparison.

At the Third UNIDO Interregional Symposium on the Iron and Steel Industry held in Brasil in 1973, a unit cost of $400 per annual ton capacity was generally accepted as a basis for computing the capital costs of establishing new steel capacity in developing countries.

In the Far East between 1950 and 1973, capital costs for iron and steel plants up to 3 million tons a year capacity have risen as follows:

	Stage	Year of completion	Dollars
Chiba	1st	1950	60
Chiba	2nd	1955	100
Wakayama	1st	1960	150
Fukuyama	1st	1965	140
Kashima	1st	1970	200
Pohang	1st	1973	350
Kooshiung		1974-1975 (planned after oil price increase)	650

It can be seen that between 1950 and 1960, the capital cost per ton per year more than doubled (250 per cent); between 1960 and 1970, it went up by another 75 per cent. After the oil price increase, the estimated cost for plants planned for completion went up by more than 100 per cent between 1973 ($320) and 1976 ($650 for Kooshiung).

At the Working Group Meeting of the follow-up of the Third Interregional Symposium on the Iron and Steel Industry, held in November 1975, this issue came up for discussion. The consensus of the steel experts was that an average capital cost of $750 per ton per year would be reasonable for another decade; for future projections up to 2000, a capital cost of $1,000 per ton per year would be needed owing to rising capital costs of plant equipment, land, infrastructure facilities and services, and the high cost of inventories, maintenance, training facilities, and the like.

It is necessary, however, to take into account the differences in the investment cost per ton per year for the establishment of new integrated steel plants on green-field sites, the expansion of existing plants, and the operation of semi-integrated plants (smaller module of about 1 million tons a year capacity) using the direct reduction/arc furnace route.

The capital cost per ton annual steel capacity figures indicated are furnished in United States dollars for the sake of uniformity of presentation and comparison. Because of the devaluation of the United States dollar in recent years and the effects of inflation on the currencies of countries that supply capital equipment for the steel industry

(Federal Republic of Germany, Japan, Soviet Union, United Kingdom, and United States, for example), the data given in tables 8 and 9 represent general trends and are by no means universally applicable to all countries and regions producing iron and steel or supplying capital goods for such production through normal business and aid transactions and bilateral and multilateral assistance programmes.

3. Sources and forms of financing - experience of developing countries

Measures to promote the local currency financing of the iron and steel industry from internal sources depend on a country's fiscal policies. There is no universal measure that can be applied to boost local finances. Nevertheless, local currency financing has to be done in such a way that it inhibits inflationary trends.

As far as foreign exchange for the steel industry is concerned, several avenues are open to the developing countries. They include:

(a) Bilateral financial aid on long-term loan at low interest rates payable over 20-30 years with periods of grace incorporated;

(b) Equity participation by foreign firms or countries on an appropriate basis in line with the country's industrial policy;

(c) Loans from international banking agencies (IBRD, ADB, IMF, IDB) on acceptable terms;

(d) Bilateral and multilateral trade and barter for the import of steel-plant equipment against exports of commodities such as textiles, cotton, jute, sugar, and cement;

(e) A variety of arrangements based on (a) to (d).

The financing of a highly capital-intensive steel industry is a complex subject, particularly where the developing countries are concerned. International technical consultants often act as promoters for capital investment in steel projects in developing regions and countries when they discuss their feasibility studies, technical and economic evaluation and detailed project reports with capital financing agencies. Quite often the consultants obtain the steel plant equipment from several advanced countries whose Governments offer suitable long-term credit terms to the developing country. While much can be said in favour of such arrangements, the developing country may have no choice but to agree to whatever prices are asked for the equipment - prices that are often much higher than world market prices. In such cases, the 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, both sides find this lucrative.

In some cases, the developing country agrees that the foreign firm will acquire equity up to the amount of the foreign exchange requirements of a steel project, while the indigenous costs of civil engineering, building, and local manufacture of structural material and any equipment that can be produced locally are met by the developing country. But this depends on the policy of the developing country concerned. Where such arrangements are made, the profits of the project are divided appropriately between the two parties over a long agreed period (ten to twenty years or indefinitely), and the management of the project is shared: a foreign board would have a chairman (or president) who is a national of the developing country, and a national board would have a foreign chairman. There are many arguments both for and against these arrangements, and there is no universal yardstick to judge their respective merits.

Capital financing of the steel industry under bilateral or multilateral trade agreements is much less common but has been employed in a few developing countries when payments in foreign exchange (for the supply of the steel plant equipment and technical expertise) are made on a long-term basis in the form of exports of traditional items (tea, coffee, jute, cotton, textiles, hide, skins and leather goods etc.) or products of the steel plants to be erected.

In a few developing countries wholly indigenous capital financing has been employed successfully for putting up small iron and steel plants. In such cases, the capital costs of the plants in local currency have been fairly high (in equivalent foreign currency) but no higher than they would have been ultimately if financed by foreign bank loans and long-term credit.

In the case of a large integrated steel plant, it is usual to place orders for the plant equipment and ancillaries with a consortium of firms rather than a single firm. This consortium can consist of leading firms from one country or from several countries. If necessary, it can also arrange long-term credit facilities on a Government-to-Government basis 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 cease once the results of the performance tests are satisfactory. These tests are normally confined to the attainment of the design output figures over a specific period of time and are carried out under stipulated conditions; all the variables have to be negotiated and agreed upon well in advance by the parties. The enormous number of loopholes in multipartite agreements indicates how technical consultants operate. An inexperienced owner (in the public or private sector) in a developing country has to face a formidable array of alignments against which he needs to be fully protected if the best interests of the developing countries are to be served.

If a developing country makes a "turn-key" contract (a package-deal contract as opposed to split contracts) for the supply, construction and commissioning of an entire steel plant, the immediate effects may seem advantageous, but in the long run the plant may be run into unforeseen difficulties and even financial problems. There are subtle points to consider that are not readily identifiable, even though "turn-key" steel-plant contracts appear attractive in a developing country and seem to simplify responsibilities. The experiences of some developing countries with "turn-key" contracts have been unhappy because capital costs have been high and litigation over the interpretation of various clauses in contracts and agreements has dragged on for protracted periods. Such problems should be carefully dealt with when contracts are being negotiated and drafted.

In developing countries which prefer public-sector steel enterprises aided by long-term loans and favourable credit terms from co-operating countries, the picture is somewhat different. If, for example, a foreign country provides a loan to cover all or part of the foreign exchange component of the integrated steel project, tenders for the plant equipment are often confined to firms of that country, and this may sometimes limit the efficiency of the new plant. Even where global tenders are employed, 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 of such situations in developing countries. It is true that the state ultimately pays the capital costs for the steel plant, but the consumer has to pay higher prices for indigenous steel.

Issue No. 7

INTERNATIONAL TRADE IMPLICATIONS

Issue 7 (a)

What are the main features, and implications for developed and developing countries, of the present international trade covering the raw materials and steel semis?

Issue 7 (b)

What are the main obstacles in terms of tariff and non-tariff barriers hindering the growth of the steel industry in developing countries?

Issue 7 (c)

What are the prospects and measures including international stocking arrangements recommended to ensure the stable growth of the world trade in raw materials and fuels related to steel production for the mutual benefit of developed and developing countries?

Issue 7 (d)

What are the prospects, and measures recommended, to achieve a more balanced international steel trade on the basis of the experience of the sector in developing countries? What will be the role of capital goods trade in this connexion?

VII. BACKGROUND AND SUPPORTING INFORMATION ON ISSUE NO. 7[16/]

1. The main features and implications of international trade in iron and steel

(a) Global

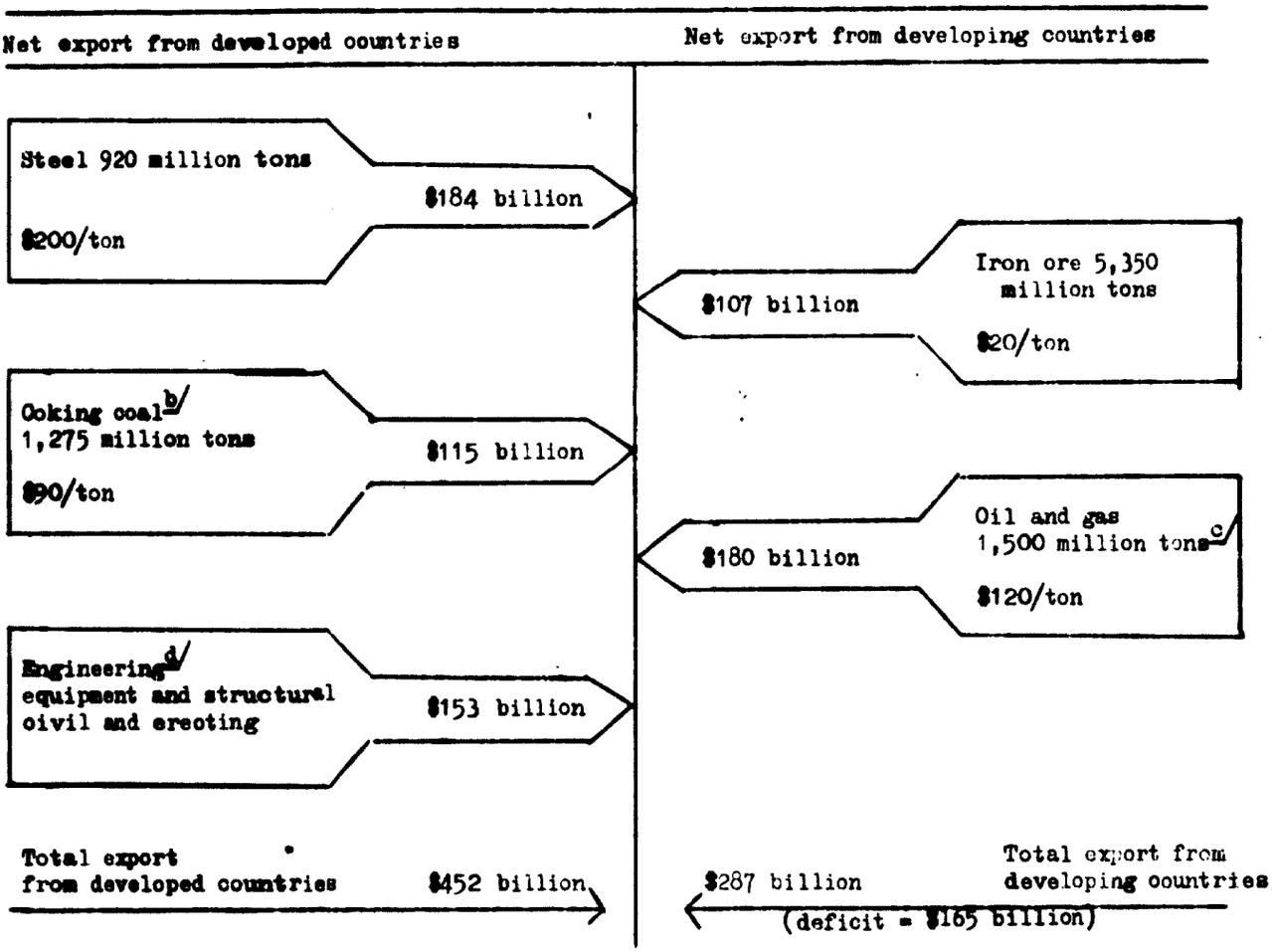
The most striking feature of trade in iron and steel between the developing countries and the developed countries over the next quarter of a century will be the gross imbalance in their net trade flows. This will be most pronounced in three areas: net import by developing countries of iron and steel products at all stages of production; the large imports of capital equipment and related technology associated with the industrialisation efforts of the developing countries in this sector and the financial implications of the investment involved; and the enormous expenditures resulting from the exploitation and shipping costs associated with meeting the world's iron-ore requirements over this period. The general picture, and its implications, may be outlined as follows:

(i) Total exports from the developed countries to the developing countries may reach about $450 billion, and developing countries' exports to the developed countries should amount to some $290 billion. This suggests that the developing countries will experience a trade deficit of some $160 billion over the next 25 years (see figure VII);

(ii) While the developing countries' imports of steel products and coking coal will be almost covered by their exports of iron ore, oil and gas, the necessary purchases of engineering, equipment, heavy structures and construction works cannot be financed from exports earnings and will therefore constitute most of the developing countries' deficit;

16/ The background and supporting information for this issue is based substantially on the contribution and collaboration of the UNCTAD secretariat in compliance with resolutions adopted at the Second Conference of UNIDO in March 1975 and at UNCTAD IV in May 1976.

Figure VII. Trade ctly related to steel industry between developed countries and ..eloping countries a/ (1976-2000 accumulated)



a/ Based on estimates of table 4 and current (1976) unit price. Very rough estimate to indicate magnitude of trade.

b/ Assuming 50 per cent of developing countries' consumption is to be imported from developed countries.

c/ Assuming consumption of 100 kg per ton of steel and that 60 per cent of developed countries' consumption is to be imported from developing countries.

d/ See table 9.

(iii) In order to facilitate the huge volume of trade, mutual aid and co-operation between developing countries and developed countries and between the developing countries themselves are of extreme importance. Consultations between them in all fields related to the iron and steel industry, should be continued and accelerated.

World trade in steel rose from 60 million tons in 1965 to about 90 million tons in 1970, 97 million tons in 1972, and an estimated 110 million tons in 1973. Figure VIII shows the position for imports of steel by developing countries. It can be seen that, while the increase in tonnage imported has been approximately linear since 1965, the total cost of imports has grown much more rapidly as a result of the severe price increases over the period. In 1974, total tonnage imported was 40 million tons at a total cost of $12 billion. The attainment of self-sufficiency by 2000 will require continued imports of steel by developing countries at an even higher rate and will thus place a continuous heavy burden on their already limited foreign exchange resources.

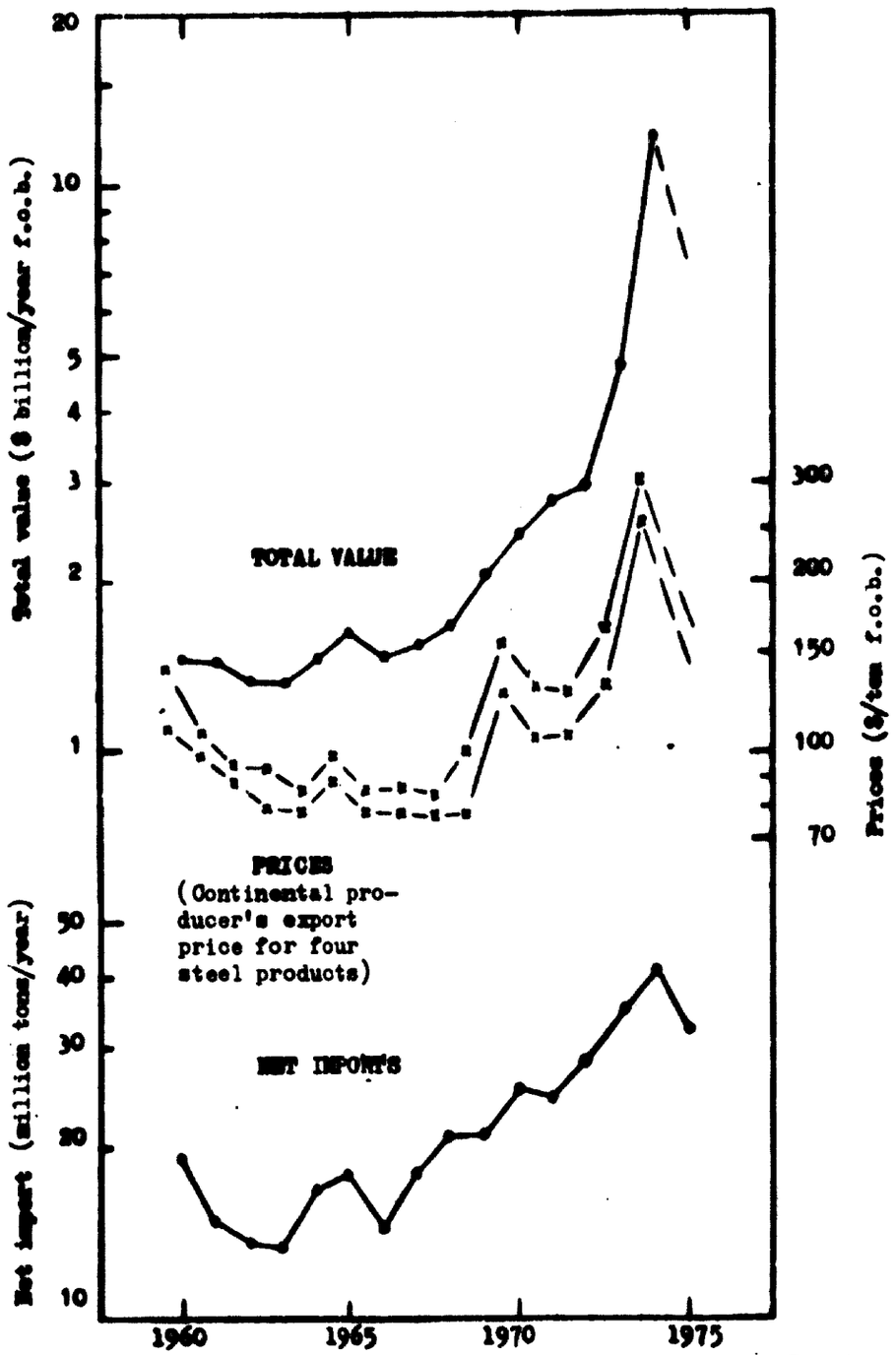
The uncertainty of price fluctuations in recent years must also be noted. The price of reinforcing bars, for example, climbed steadily from $100 per ton in January 1972 to $122 per ton a year later. By January 1974, the price had more than doubled, to $280 per ton, and reached $320 per ton in April 1974, although it has fallen again since then. These fluctuations in steel prices coupled with uncertain deliveries and rising freight costs have created serious problems for the developing countries in meeting their growing steel requirements. One way to reduce this problem might be the institution of co-operative arrangements between developed countries and developing countries that could lead to mutually beneficial long-term contracts establishing pre-determined price ranges for steel products. The development of regional and inter-regional trade agreements between developing countries could also help to stabilise prices.

The developing countries are exporters of large amounts of iron ore (see figure IX). Sub-Sahelian Africa, Latin America and South Asia are large exporters; the Arab countries and South-East Asia produce, consume and export very little.

Trade in iron ore was about 265 million tons in 1970, 330 million tons in 1972, and 350 million tons in 1973. The share of the developing countries was about 130 million tons in 1970, 150 million tons in 1972, and 170 million tons in 1973 or 49 per cent, 45 per cent and 48 per cent respectively.

In most industries, price variations are most marked at the input (commodities and raw materials) stage and diminish as the end-product stage is approached: with steel, the reverse is true.

Prices of some raw materials have been quite stable in recent years, compared with the prices of the steel products and scrap shown in figure X. Others, however, have risen considerably and are causing great concern about the future development of the steel industry.



(Price data source: OECD, The Iron and Steel Industry in 1973 and Trends in 1974)

Figure VIII. Net imports of steel by developing countries from developed countries, 1960-1975

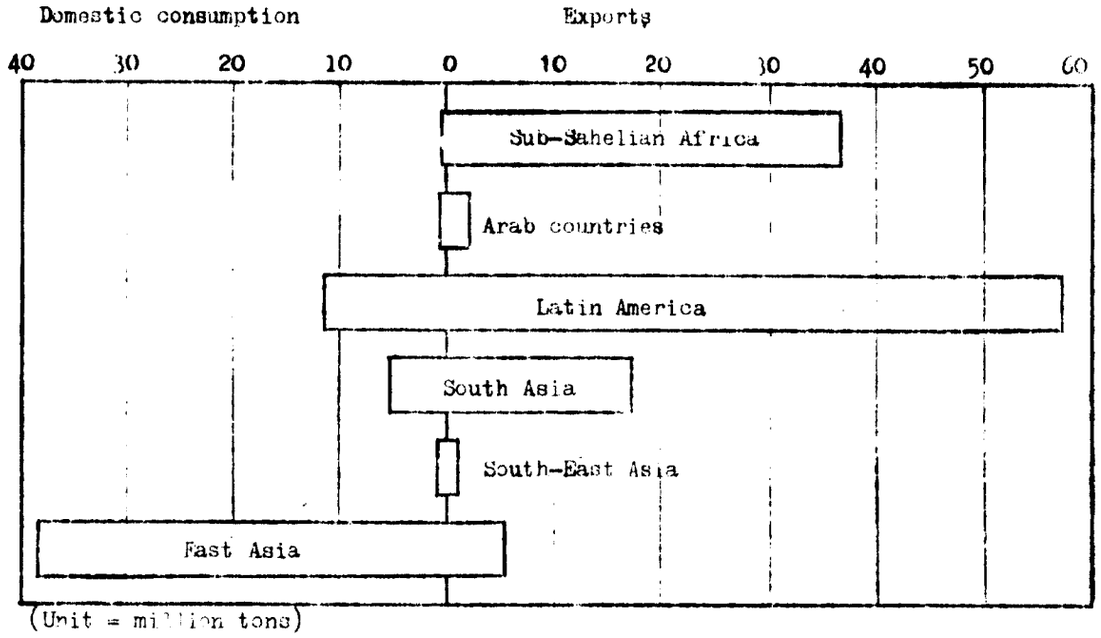
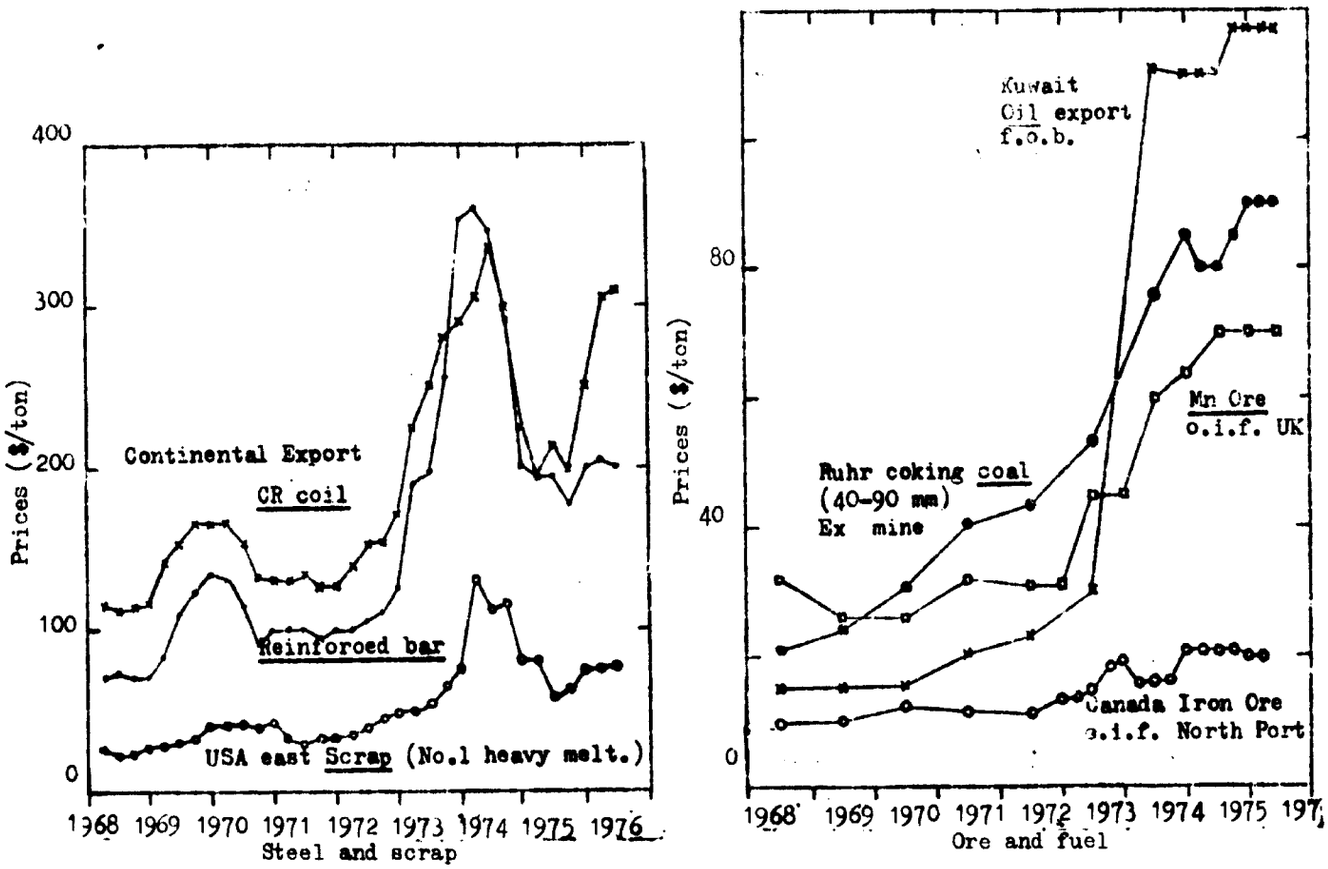


Figure IX. Domestic consumption and exports of iron ore - developing countries, 1973



Note: These price fluctuations represent the general trends and do not cover fluctuations of prices in all steel producing/exporting countries: spot prices have been significantly higher in some cases (coal, scrap etc.).

Sources: Various issues of Metal Bulletin and Monthly Commodity Price Bulletin, and Metal Bulletin Handbook (1974).

Figure X. Price fluctuation of steel, scrap, ore and fuel in recent years

Major iron and steel products accounted for some $1 billion of the developing countries' exports to developed countries in 1974 (see table 10) and this is less than one eleventh of the corresponding exports from developed countries.

Table 10. Developed countries' imports of major products of iron and steel from developing countries and territories, 1973 and 1974

SITC[a/] code	Short description	Value of imports ($ million)		Growth rate (per cent)
		1973	1974	
671	Pig iron	321	486	51
674	Plates and sheets of iron and steel	123	200	63
678	Iron and steel tubes and pipes	57	145	154
673	Iron and steel bars and shapes	86	137	56
672	Ingots of iron and steel	47	22	-52
	Other	13	21	62
	Total: Iron and steel	649	1,018	57

Source: UNCTAD.

a/ Standard International Trade Classification.

The major importing developed countries in 1974 were the United States ($523 million), France ($116 million), Italy ($102 million), Japan ($98 million) and the Federal Republic of Germany ($66 million). The increase in the imports of iron and steel from developing countries was particularly rapid in 1974: United States (97 per cent); Japan(76 per cent); France (52 per cent). Italian imports increased very little in value, however, and imports by the Federal Republic of Germany fell by 12 per cent. The main developing country suppliers in 1974 were the Republic of Korea ($321 million), New Caledonia ($184 million), Yugoslavia ($137 million) the Dominican Republic ($97 million), Mexico ($48 million), Argentina ($46 million) and India ($32 million). Expansion of exports in 1974 was particularly rapid in the case of the Republic of Korea (179 per cent) and Mexico (85 per cent). Large individual flows of trade in iron and steel between developing countries and developed countries, involving $30 million or more in 1974, were United States imports from the Republic of Korea ($260 million), the Dominican Republic ($55 million), Mexico ($47 million), Argentina ($43 million) and Brazil ($36 million); France's imports from New Caledonia ($106 million); and Italy's imports from Yugoslavia ($58 million).

Developed countries' imports of ore and concentrates in 1974 were valued at $2.5 billion; semi-manufactures, $1.1 billion; and finished manufactures, $200 million. Finished manufactures thus accounted for only 5 per cent of imports by developed market economy countries for the iron and steel sector, whereas raw materials accounted for 66 per cent of imports for the sector.

Exports of raw materials from developed countries to developing countries are insignificant, and finished manufactures accounted for 10 per cent of the sector's exports. The bulk of developed countries exports to developing countries consisted of semi-manufactures worth

$12 billion. The main items of semi-finished manufactures of iron and steel exported from developed countries to developing countries in 1974 were plates and sheets ($3.6 billion), bars and shapes ($2.4 billion), ingots and other primary forms ($1.4 billion), finished structures ($700 million), hoop and strip ($400 million) and wire ($300 million). Expansion in exports to developing countries was particularly rapid in 1974 in the case of tubes and pipes (170 per cent) and bars and shapes (145 per cent). The principal items of finished manufactures of iron and steel exported to developing countries in 1974 were tools ($500 million) and locksmiths' wares ($200 million).

(b) Trade between the developing countries

There are many arguments to support the idea that the developing countries should actively pursue increased trade in iron and steel products between themselves and not depend too much on exports to developed countries markets alone. These arguments include:

(1) The rationalization of such regional factors as relative market sizes and distribution of resources;

(2) The structure of tariffs and other non-trade barriers in developed countries' markets;

(3) Transportation cost considerations;

(4) The realities of the structure of the international steel market (intergovernmental and private industry agreements on market shares, voluntary export constraint, pricing, investment and specialization policies);

(5) The instability of iron and steel prices in the markets of developed countries.

There is already trade in iron and steel products between developing countries. The following estimates (tables 11 and 12) of regional and inter-regional trade in iron and steel products between developing countries are based on a sample of 50 developing countries that supplied trade data. The figures include only the trade flows between these 50 developing countries and therefore provide only an indicative picture of the trade links between all the developing countries in 1973.

Perhaps the most important indication this data provides is the extent of regional and inter-regional trade in iron and steel. Inter-regional trade is most notable between such distant regions as Asia, the African regions and developing America. Existing trade links, whatever their commercial and other bases may be, should be further exploited and expanded so as to augment the division of labour necessary to promote the industrialization goals set by the Lima Declaration.

An analysis of the total trade flows by stage of processing yields some interesting information about the level of industrialization in the iron and steel sector. The bulk of regional and inter-regional trade between developing countries is in semi-manufactures, which account for some 76 per cent of the total value of exports from all countries at all stages of production. This suggests that (a) there is considerable scope for further "down-stream" processing in the future and (b) the developing countries will continue to depend on imports of finished manufactures from the developed countries until they are gradually replaced by imports from the more advanced developing countries. The regions with the most trade in the more sophisticated finished manufactures of iron and steel in 1973 were Asia ($28.8 million), the Middle East ($17.8 million) and developing America ($8.1 million).

Table 11. Regional export trade of developing countries in iron and steel products in 1973

Region	Intra-regional iron and steel exports as percentage of total iron and steel exports	Value of intra-regional iron and steel exports ($ million)
Asia	71	119.5
Latin America	93	97.5
North Africa	84	0.138
Other Africa	89	3.4
Middle East	55	16.6

Source: UNCTAD secretariat calculations.

Table 12. Inter-regional export trade of developing countries in iron and steel products in 1973

Direction of trade flows	Inter-regional iron and steel exports as percentage of total iron and steel exports	Value of inter-regional iron and steel exports ($ thousand)
North Africa to:		
Other Africa	5	138
Middle East	1	272
Asia	less than 1	1
Other Africa to:		
North Africa	9	341
Developing America	less than 1	2
Middle East	less than 1	17
Asia	1	33
Yugoslavia a/	less than 1	11
Developing America to:		
North Africa	less than 1	25
Other Africa	1	888
Middle East	2	2,116
Asia	2	2,189
Yugoslavia a/	2	2,309
Middle East to:		
North Africa	17	5,068
Other Africa	3	908
Developing America	less than 1	98
Asia	25	7,620
Yugoslavia a/	less than 1	81
Asia to:		
North Africa	1	2,366
Other Africa	4	7,394
Developing America	13	22,363
Middle East	10	17,211
Yugoslavia a/	less than 1	216
Yugoslavia to:		
North Africa	47	7,164
Other Africa	2	236
Developing America	less than 1	48
Middle East	28	4,268
Asia	23	3,523

Source: UNCTAD secretariat calculations.

a/ Yugoslavia is treated as a separate region.

2. Tariff considerations

The uniqueness of the iron and steel sector in any economy helps to explain its present market structure, and any harmonized market practices it may employ. Given these realities it is understandable that imports, the principal source of potential competition, are closely scrutinized and curtailed in various ways - by cartel measures and Government-sanctioned trade policies.

Developing countries intending to expand or develop iron and steel exports to developed countries' markets must take into account the obstacles to trade that are generated by tariffs and non-tariff barriers (NTB). The average post-Kennedy-Round most-favoured nation, (MFN) tariff rates on iron and steel products range from zero at the raw material stage of production to 6.7 per cent at the intermediate stage or semi-manufacture level and 10.2 per cent at the final or finished manufactures level.[17/] While tariffs on individual items of iron and steel within each stage of processing differ, the progressive increase of the tariff as the stage of processing advances is apparent. Developing countries planning to gain access for their exports of processed steel products to the markets of developed countries should take into account the effect that this progressive tariff structure may have on their competitive position, particularly where exports of finished products are concerned.

The Generalized System of Preferences (GSP)offered by most developed countries offsets to some extent the restrictiveness of the tariff structure. The GSP schemes of most preference-giving countries provide for duty-free treatment of most iron and steel products. The most important of these schemes, however (those of the EEC, Japan and the United States), impose on imports quantitative restrictions that limit the benefits of preferred market access. In the EEC and Japanese schemes, these restrictions take the form of quotas under which all imports from all developing countries are admitted duty-free up to a predetermined limit. Any imports in excess of this limit are subject to full MFN duties. Imports from individual countries cease to be eligible for preferential treatment once a predetermined share of the total quota has been filled. Since the quotas are annual, however, all developing countries have equal access to them at the start of each new year. The quantitative restrictions embodied in the United States scheme are rather different: if imports of a given item from a given country exceed $25 million or 50 per cent of total United States imports of that item, that country is subsequently denied preferenoial treatment for all time, unless presidential approval is given for its renewal.

These restrictions and the uncertainty they cause, along with certain produot exclusions, stringent rules of origin that qualify goods for preferential treatment, and discriminatory beneficiary lists, require that each developing country apprise itself of its eligibility under each separate GSP scheme and for each iron and steel item it wishes to export. It should also be recognized that the GSP, because of the uncertainty of its duration and administrative rules, is not by itself a sufficient condition to warrant plans for significant increases in iron and steel exports. The underlying tariff barriers prevail and should always be taken into account in any decision to concentrate on exports to developed countries' markets.

17/ These are the unweighted average tariffs of the EEC (of 9), Japan and the United States.

The most important other special preferential scheme is that set up between the EEC and 46 African, Caribbean, and Pacific (ACP) developing countries. These countries are mostly the associated African and Malagasy States members of the Yaoundé Convention and a number of the Commonwealth developing countries. Under the EEC-ACP Convention of Lomé, the 46 member States are accorded duty-free preferential treatment on all industrial and primary products listed in chapters 25 to 99 of the Brussels Tariff Nomenclature. This arrangement particularly affects 21 of the 29 least-developed of the developing countries (LDC). Unlike the GSP, the Lomé Convention treats all ACP member States as one area for rules-of-origin purposes. This "cumulative treatment" clause opens the way for co-operative industrialization efforts by allowing member States to specialize and combine inputs for duty-free export to the EEC.

The progressive nature of tariffs on exports of iron and steel products from developing countries to developed countries reduces any competitive advantages. This applies, however, only to products not accorded preferential treatment under the GSP. There are two ways in which the developing countries can attack these barriers: they can press, individually or jointly, for improvements in the GSP product coverage and removal of the uncertainty caused by the quantitative restrictions, rules of origin and stringent administrative rules imposed under some of the schemes; and they can participate actively in the GATT Multilateral Trade Negotiations to reduce the MFN rates.

The tariffs currently in force in the developing countries themselves, and the principles underlying their present structure, should be scrutinized and re-evaluated in the light of present industrialization and trade-expansion plans. Significant tariff changes may be needed to accomodate these plans, particularly where the iron and steel sector and the growth of the manufacturing sector are concerned. Tariff reforms that increase the profitability of domestic iron and steel and capital goods production could overcome present constraints on the growth of the manufacturing sector.

Co-ordination of the tariff reform efforts of the developing countries should also be attempted so as to maximise the specialization and division of labour in iron and steel production and general industrialization plans. Maximum attention should be given to designing the tariffs to take into account the complementary needs of the developing countries, particularly those at different stages of industrialization. On a broader front, consideration should be given to formulating sub-regional and inter-regional preferential tariff schemes for trade between the developing countries.

3. Non-tariff barriers

Besides tariffs, there is another category of obstacles to trade in iron and steel; these are the special restrictions usually referred to as non-tariff barriers (NTBs). They are broadly defined as any measures other than tariffs, that restrict imports and they include such measures as import licences, exchange controls, quotas (including voluntary export restraints), import surcharges, valuation procedures, documentation requirements, customs fees and deposits, patents and trademarks, and health and safety rules.

Unlike tariffs, NTBs are very difficult to quantify for an estimate of the degree to which they restrict trade. Because of the special way in which NTBs are imposed and the difficulty of measuring their effect, it is unlikely that they will be substantially reduced or eliminated in the Multilateral Trade Negotiations (MTN) in progress in Geneva. The developing countries should therefore take NTBs, as well as tariffs, into account in weighing the decision to export iron and steel products to developed countries.

The work being done in the GATT Multilateral Trade Negotiations involves three groups: Non-Tariff Measures, Tariffs, and Sector Approach.

The Non-Tariff Measures Group has set up four sub-groups dealing with quantitative restrictions, technical barriers to trade, subsidies and countervailing duties, and customs matters. The items on its agenda include the establishment of a second list of non-tariff measures and the procedures for negotiations on non-tariff measures not dealt with multilaterally. In the sub-group on quantitative restrictions, an initial step towards solving the problems has been taken by starting consideration of existing quantitative restrictions in detailed bilateral and multilateral consultations and discussions. Discussions on licensing procedures are based on two ad referendum texts, one on automatic licensing and one on licensing used to administer import restrictions. In the sub-group on technical barriers to trade, work is progressing on the proposed code of conduct for preventing technical barriers to trade (often referred to as the draft standards code), which is intended to deal with the problems raised by standards and packaging and labelling regulations. The applicability to the draft code of the definitions drawn up by the United Nations Economic Commission for Europe and the International Organization for Standardization is being examined. Delegations have also been invited to make proposals on how marks of origin should be dealt with in the negotiations.

4. Transportation costs

The transportation costs of iron and steel products are a third major factor to be considered by developing countries in their planning for the future patterns of trade in this sector. Developing countries other than those which are geographically close to developed countries' markets (the North African and Middle Eastern countries close to Europe, some of the Asian countries situated close to Japan, and those Latin American countries with easy access to the North American market) may find that ocean transportation costs erode whatever competitive advantage their exports otherwise would have in developed countries' markets. Distance, the value of iron and steel products, size, and handling difficulties are all factors in the calculation of the rate. Consequently, as developing countries seek to export more highly processed iron and steel products, they will face rising ocean freight rates[18] that will be further inflated according to the distance to the market, availability of tonnage, bulkiness of the products, and other considerations that affect rates. Seen in this light, regional and inter-regional iron and steel trade may be preferable to long-haul exports to developed countries' markets, since the alternative may be for developing countries to absorb freight costs by setting lower f.o.b. prices in order to remain competitive.

18/ The increase in value at each stage of production could be high enough, however, to make the freight a smaller proportion of landed value smaller than it is for less highly finished products.

Transportation costs can constitute a considerable barrier for many developing countries wishing to export to distant developed-country markets. In many instances, however, the higher rates they pay are not solely a function of distance but are related to the relatively small volume of continuous shipments. The distance factor can be partially overcome by more trading between the developing countries themselves, but attention also must be given to co-ordinated efforts to create and strengthen national and regional organisations of iron and steel exporters, and to the possibilities that shippers in general have of obtaining from the shipping conferences special promotional freight rates in cases where iron and steel products are non-traditional exports. These bodies should also seek to improve and co-ordinate their efforts to secure effective consultation and negotiation with shipping conferences or carriers on the establishment of new or better shipping routes between the developing countries. The traditional lack of price competition between carriers requires that shippers from developing countries must show a co-ordinated and united front if they are to negotiate effectively new and more equitable shipping arrangements.

5. The structural characteristics of the international steel market

Although the structural, conduct and performance characteristics of the international market for iron and steel are not specifically mentioned in Issue 7 (b), developing countries that are expanding their iron and steel trade should be aware of them and take them into consideration.

The structure of national iron and steel markets can be described as either monopolistic (public or private) or oligopolistic. The conduct and performance characteristic of the national structurals are also largely characteristic of the international market.

Most of the steel-producing sectors existing or planned in developing countries are state-owned or state-controlled enterprises with natural-monopoly or state-monopoly characteristics. In many instances, however, the industry is either too large for current domestic demand for iron and steel products or is not expanding fast enough to satisfy domestic demand. In both cases participation in international trade is necessary: in the first case export markets must be sought as an outlet for excess capacity; in the second case iron and steel products must be imported to meet the demand for specialised products and domestic demand.

The success of efforts by developing countries to expand their share of total trade in iron and steel will partly depend on whether or not they understand the effect of the contemporary structure and practices of the world steel market on international trade in iron and steel.

The present structure of the steel markets in the major developed countries, and the cartel and other restrictive business practices which emanate from it, provide the steel firms of these countries with certain obvious advantages in world steel markets. There is little that the developing countries can do to change the realities of present trading patterns. But with proper planning and co-ordination, supported by a strong desire and will, it may be possible to change the patterns and composition of trade over the next 25 years.

Without resorting to outright imitation, the steel-producing and steel-consuming developing countries can nevertheless gain some insights on how to improve trade in this sector by closely scrutinizing the established practices of their counterparts in the developed countries. The rationalization of steel production and trade must be viewed not only from the narrow national point of view but also in relation to their role in regional and sub-regional economic groupings. Whether or not there is participation in formal integration schemes, new initiatives require priority attention. One of the first priorities should be to improve existing and create new intergovernmental machinery and institutions in order to better harmonize the national and common interests of the developing countries with respect to this sector. Close attention should be paid to the establishment of complementary agreements between developing countries with export capacity and developing countries with import requirements. Such agreements might include: industrial co-operation at the enterprise level both with developed countries and between developing countries' steel producers; international subcontracting that contributes not only to the generation of employment, but also to the creation of skills, the transfer of technology and the development of entrepreneurial capacity; joint ventures between developing countries and developed countries (with the latter having limited equity participation or with collaboration arrangements of a purely contractual character); and judicious policies regarding developing countries' tariffs (the use of preferential and discriminatory tariffs alike to allow preferred access for iron and steel related imports from developing countries and developed countries who are participating in co-operative arrangements). It may be useful to explore the possibilities of introducing orderly marketing arrangements, including the minority participation of major developed countries' steel firms, in order to rationalize and order the distribution and staging of iron and steel trade between the developing countries.

The present competitive power and position of the developed countries in steel trade with developing countries cannot be ignored. As the traditional net exporters of iron and steel products, at all stages of processing, to the developing countries, the developed countries are likely to maintain their foothold in developing countries' markets. This is especially the case where their transnational affiliates are participating in development at all stages of industrialization. It will take a substantial effort by the developing countries to overcome the inertia resulting from these traditional established commercial ties.

Import substitution policies favouring the iron and steel sector are certainly relevant in this regard. The tariff and other supporting measures of the developing countries need to be adapted to the requirements of the sector, particularly during its "infant industry" period. The significance of this sector and its influence on all "down-stream" industrial activities must also be taken into account in formulating protective policies. Where protective measures may lead to increased costs and prices of steel products, complementary policies should be adopted that offer effective fiscal and other subsidies to other steel-using industries so as not to reduce their competitiveness. Agreed orderly marketing arrangements might be another way to facilitate operations during the transition period required before the changes in the pattern and composition of the world iron and steel trade can be made.

6. The question of price stability

The relative stability of world prices for iron ore in the past in contrast to other inputs such as fuel, coking coal and manganese has already been pointed out. In view of the estimates which indicate that world consumption of iron ore may reach 1,900 million tons by 2000 - more than twice the present mining capacity - iron-ore price formation practices may be subjected to change. Given the common interest of developed countries and developing countries, the various modalities for maintaining relative price stability should be discussed. This is particularly important to developing countries because they are responsible for between 40 and 50 per cent of the iron-ore trade and because iron ore is a major generator of their foreign exchange earnings. Since, on the other hand, coking coal and manganese come mainly from developed countries, there should be some grounds for an exchange of views on the subject.

UNCTAD is currently undertaking the initial negotiations on the establishment of a common fund under its integrated commodity approach. It is envisaged that the common fund will be used to maintain the prices for a set of commodities yet to be fully determined. The provisional list of 17 commodities that are under consideration includes iron ore. UNCTAD meetings on iron ore are tentatively contemplated for October 1977.

7. Trade in capital goods

Many aspects of the role of capital goods' trade under this sub-issue have been treated extensively under Issue 5. The importance of attaining relative self-sufficiency in this sector is almost self-explanatory. The development of the capital-goods sector is crucial to the fulfilment of the goal of industrialization.

For many developing countries not currently at a more advanced stage of development, this sector will not come into its own for some while and will constitute one of the more heavy drains on foreign exchange resources.

It is in this sector, particularly in its more technologically advanced areas, where maximum co-operation between developed countries and developing countries will have to be sought. The more advanced of the developing countries also have an important role to play since they have gained the relevant experience in the application and transfer of the necessary technology in the context of their own industrial development. The development of the iron and steel industry as the leading sector is important to the success of an indigenous capital-goods sector. The more advanced developing countries should therefore use their experience to assist at lower stages of development. Financing and technical know-how will have to be sought from all sources. It is in this area where co-operation between developed countries and developing countries is most essential.

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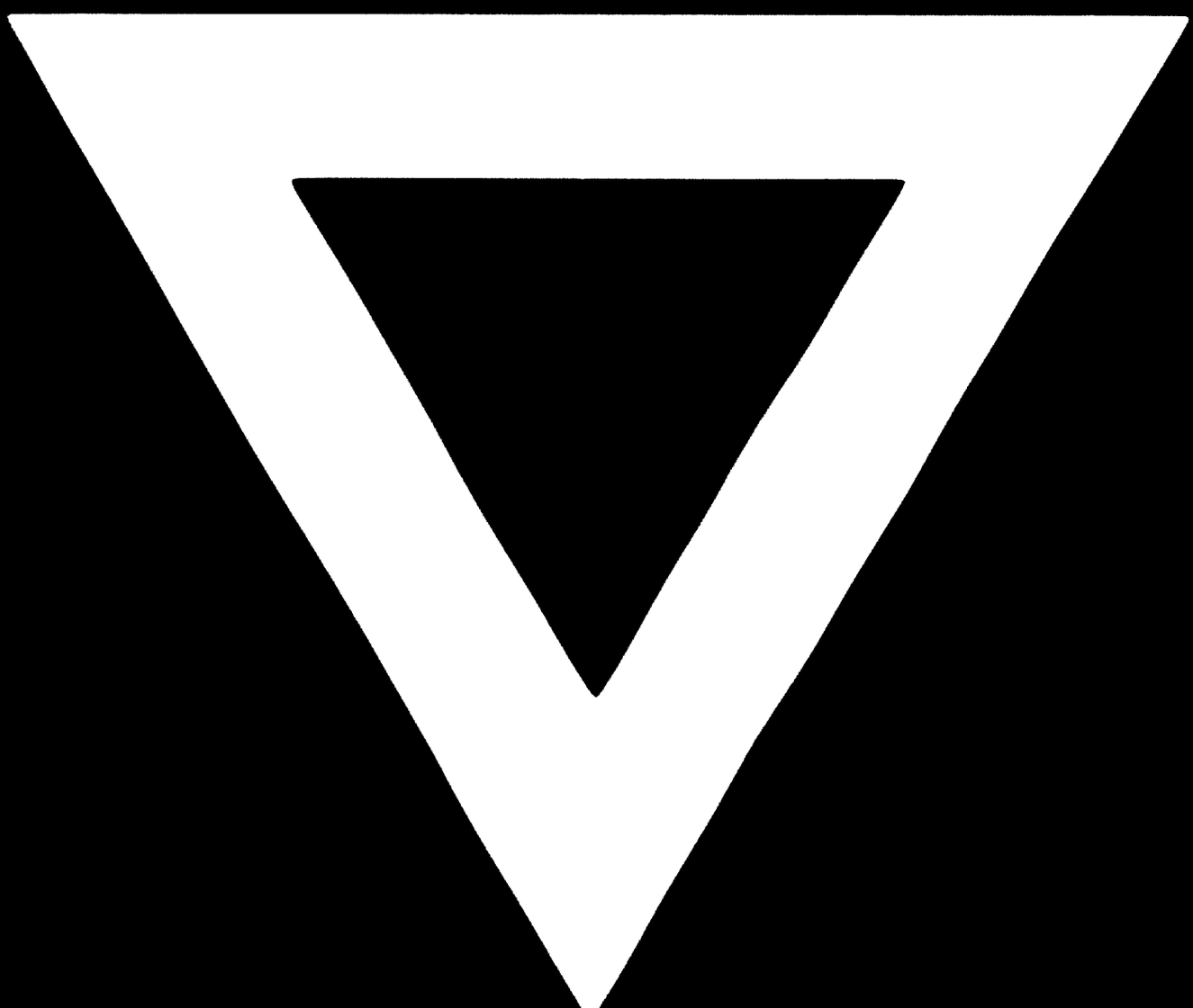

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