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Steel Works Projects in Developing Countries

A Survey for the
United Nations Industrial
Development Organisation

W.S. ATKINS & PARTNERS

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STEEL WORKS PROJECTS IN DEVELOPING COUNTRIES

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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

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CHAPTER 1 - INTRODUCTION

1.1 Terms of Reference

In September 1970 W. S. Atkins and Partners were asked by the United Nations Industrial Development Organisation to prepare a report on all integrated and, as far as possible, on semi-integrated iron and steel works projects in the developing countries, with a capacity of more than 100,000 tons per year.

Integrated works have been defined as those which start with iron ore or oxide pellets as a raw material, and semi-integrated works as those which start with scrap, pig iron or reduced pellets. Thus information was not sought for rolling mills, forges buying in steel as slabs, blooms or billets, nor for foundries making iron or steel castings without any further processing of the cast product.

It was agreed:

(i) that the definition of developing countries should exclude:

Australia
Canada
China (mainland)
Europe
Japan
New Zealand
Rhodesia
South Africa
United States
U.S.S.R.

with the exception that certain countries in Europe should be covered, namely Cyprus, Greece, Ireland, Turkey and Yugoslavia.

(ii) that published information on development plans and statistics of apparent steel consumption were to be gathered for these developing countries. Thus the report was to be prepared primarily from published data, although information was also to be sought direct from the countries concerned, through such sources as embassies, commercial offices, and trade corporations.

(iii) that all information should relate to steel works projects falling within the following four categories:

(1) now under execution;
(2) agreed upon but not yet started;
(3) planned but not yet agreed;
(4) considered for implementation in the 1970's but not yet planned in detail.

(iv) that such projects should be assessed in terms of:

(a) the source of raw materials;
(b) the type of process to be employed;
(c) the size and sector of market to be sought;
(d) the approximate capital cost of the development;
(e) status of the project, in terms of the categories indicated above.

(v) that the information acquired was to be treated analytically, in terms of the likelihood of the projects concerned going ahead in relation to the markets envisaged for their output. The likely impact of the projects on the iron and steel industry of the country concerned, or of the region, was also to be considered. For this purpose, the developing countries should be classified by regional or sub-regional zones.

1.2 Method of Study

All sources of non-confidential information in the possession of W.S. Atkins and Partners were utilised, and various libraries were used, such as the Iron and

Steel Institute in London. The co-operation of the British Steel Corporation in supplying information drawn from a wide range of publications, was invaluable as was the assistance of the Metal Bulletin. Assistance was also received from many other sources, including the Projects Group of the Department of Trade and Industry, the Commonwealth Development Corporation, Ashmore Benson Pease & Co., and John Miles & Partners.

In order to obtain information direct from the countries concerned, a questionnaire was drawn up - an example has been included as Appendix I. It was decided that, in general, no approach should be made to countries with a population below 1 million, since in terms of per capita steel consumption a smaller population would not justify a 100,000 ton steel works. A few exceptions were made - for instance, Bahrain and the Gulf States were included in view of the potential investment in an iron and steel industry out of their oil revenues. On this basis, it was necessary to make some approach for information to a total of 94 countries, distributed among the following major regions:

Africa:	37
Latin America:	24
Middle East:	11
Far East:	17
Europe:	5

It should be noted that the Far East is taken to include the Indian sub-continent, while the Middle East includes Egypt and Iran, but not Turkey.

The first approach was made to the embassies of these countries in London, and to British embassies in the respective countries. They were asked both for any information they possessed on iron and steel works projects, and also for the most appropriate person or office to whom a questionnaire might be sent. The response from the embassies was good, although considerable delay was caused by the coincidence of the prolonged postal strike in the United Kingdom. On the basis of the information supplied by the embassies, a certain number of countries were assumed to have no steel works plans within the terms of reference of the survey, and no further approach was made to these countries.

Questionnaires, or in some cases a letter asking for confirmation that information from the embassies was correct, were sent to a total of 88 countries. The actual number of questionnaire despatched was considerably higher, since several addresses of suitable information sources were obtained for many countries, and individual questionnaires were sent to each address. The response rate was good - replies were received from a total of 41 countries, of which 22 were completed questionnaires. The return was thus 46% in terms of countries, although considerably lower in relation to the total number of questionnaires despatched. By region, the returns were distributed as follows:

Region	Completed Questionnaire	Replies by Letter
Africa:	7	9
Latin America:	5	5
Middle East:	1	2
Far East:	7	1
Europe:	2	2
TOTAL	22	19

Unfortunately, replies were not received from some of the countries where there is already a well developed steel industry with known expansion plans.

1.3 Outline of Chapter Contents

Chapter 2

The information gained from the questionnaires, publications and other sources has been recorded in Chapter 2, which has been subdivided into ten regional areas. Africa has been treated as four sub-regions - North, West Central and East; Latin America has been divided into two areas only - South America and Central America including Mexico and the Caribbean islands. The Middle East and the Indian sub-continent have been dealt with independently, leaving the Far East as an area comprising the rest of Asia together with Papua and New Guinea. Finally the European countries, including Turkey, have been treated as a separate group. Details of the countries in each region are given in Appendix II.

Within the appropriate section dealing with each of these ten sub-regions, discussion of the sub-region as a whole precedes more detailed information on individual countries, under separate headings. No absolute line of distinction was drawn between those countries treated as part of the general assessment and those given individual treatment; the division differs for each sub-region, according to an assessment of the importance of developments in each country and their impact on the sub-region.

The information in Chpater 2 is complemented by a set of schedules for all countries with definite expansion plans. All available details of the raw materials, implementation date, process, crude steel capacity, product output and capital costs of each project have been given in these schedules, which are assembled in Appendix III.

Chapter 3

Estimates of the development of steel consumption and production in the developing countries during the 1970's have been given in Chapter 3. These estimates have been made in comparison with the equivalent levels during the 1960's, and have been based entirely on published statistics. The technique used to assess what level of consumption and production will be reached by 1980 was linear regression, whereby a line of best fit was drawn for the published figures for the 1960's, and extrapolated to 1980.

It was not possible to make detailed forecasts for each country, in view of the lack of information. The trends for the developing countries were therefore calculated by comparing the figures for the whole world with those for the developed countries, for which statistics are more readily available. In addition, estimates were made for each of four major regions - Africa, Asia, Latin America and Europe (developing countries only); it was not possible to single out the Middle East for this purpose.

Chapter 4

In this chapter, the alternative technological processes for steelmaking are discussed, with special attention to future trends in technology and their possible relevance to the development of the iron and steel industries of developing countries. Consideration has also been given to the particular processes envisaged for expansion projects, wherever these have been reported in sufficient detail, in order to assess the application or otherwise of new technological trends in the developing countries.

Chapter 5

This chapter considers the various factors affecting the development of an iron and steel industry, including political, sociological and economic factors as well as the technological aspects already discussed in Chapter 4.

The report concludes with a summary of the likely pattern of development during the 1970's in each of the major regions.

CHAPTER 2 - DEVELOPMENT PROJECTS IN THE DEVELOPING COUNTRIES

2.1 North Africa

General

Of the five countries in this region, only two have well-established steel industries - Algeria and Tunisia. The steel plant at Algeria's Societe Nationale de Siderurgie will become operational this year, with a capacity of 500,000 tons, which will give Algeria the biggest steel industry in North Africa. Their output of rolled steel is already higher than Tunisia's, where there is a smaller integrated steelworks with capacity of 120,000 tons of crude steel per year. Expansion at this works will be somewhat slower than in Algeria.

In Morocco, the present steel industry is small, but there are plans for an integrated works at Nador (Raskebdan), with a capacity of 120,000 tons envisaged on completion of the first stage, rising to between 250,000 and 300,000 tons, including some 20,000 tons of ferro-manganese. This plant would probably utilise local deposits of high quality iron ore and coal from the Djerada deposits, although the possibility of using a HyL direct reduction process has not been ruled out, based on natural gas from the Arwez Terminal. The intention would be to substitute home production for Morocco's fairly substantial imports. Work does not seem to have begun on this project, since the financial arrangements have not yet been finalised, although it is reported that a U.S.-French group has proposed to finance an $85 million works.

In Libya there is at present no steel industry other than a plant producing around 20,000 tons per year of reinforcing rounds, but the Government has plans to exploit local availability of natural gas and fuel oil to establish a substantial local industry based on the direct reduction process. The objective of this steelworks would be mainly to supply the rapidly growing home market for steel products, especially tube and pipe for the burgeoning oil industry as well as steel for the construction industry. It is believed that the Libyan plans are fairly tentative, and that production would not start in any event before the end of 1975 or the beginning of 1976.

There is at present only a galvanising plant of 18,000 tons capacity in the Sudan. They have plans to set up a plant by 1974 for resmelting scrap iron; the planned capacity is 18,000 tons of finished products, consisting initially of reinforcing bars.

Algeria

Algeria's iron and steel industry plans originated under the French administration about 10 years ago. The basis of planning was to exploit the country's own iron ore deposits at Ouenza and also local availability of oil and natural gas.

The plans have been broadly to build up an integrated steel industry in three stages, first by establishing ironmaking, secondly steelmaking, and finally finished products manufacture. Ironmaking is now operational, and much of the iron is being exported, particularly to Japan; building of the steelworks is well advanced with technical and financial assistance being provided by the Soviet Union and other countries. The steelworks should become operational this year, together with 10 million tons per year capacity of hot rolling and 200,000 tons per year of cold rolling mills. There are joint plans to add a third LD converter in 1973.

The rapidly developing oil and gas industry in Algeria has meant that one of the most rapidly growing domestic markets for steel has been tube and pipe. There are already some facilities for tube manufacture at El-Hadjar, but there are plans for a 160,000 tons per year seamless tube plant to be added in 1974. Looking further ahead, there are plans to double ironmaking capacity in 1975 and also to add a 400,000 tons per year bar and section mill in the same year.

Given the determination of the Algerians to develop their own integrated steel industry, there is no reason to suppose that these plans will not eventually come to fruition. In the distant future there are hopes that steelmaking capacity can be raised to 3 million tons per year, but meanwhile it is inevitable that for many years Algeria will continue to import much of her requirements. Imports in 1973 could be as much as 750 000-1,000,000 tons.

Tunisia

The foundations of Tunisia's integrated iron and steel industry were laid in 1963 when work was started on the Menzel-Bourghiba Works. Ironmaking capacity from a single blast furnace, originally 250 tons per day, is now around 400 tons per day, and there are 2 LD converters giving crude steel capacity of around 120,000 tons per year. Efforts are now being directed towards expansion in the areas of finished and semi-finished products to utilise more effectively the available capacity of the integrated works, and secondly to add electric arc or electric induction furnaces.

Phase 1 of this operation is the laying down of a wire drawing mill with capacity around 15,000 tons per annum; this is now being built.

Phase 2, for which the start-up date is tentatively put at 1973, involves additions to the existing oxygen plant, extensions to the rolling mills, additional continuous casting capacity and installation of electric furnaces. No final decision has yet been taken on the Phase 2 plans, but they would effectively increase billet capacity by 50,000 tons and wire rod making capacity by 60,000 tons.

The total cost of the Phase 1 and Phase 2 proposals is put at 3,400,000 Tunisian dinars.

2.2 West Africa

General

The steel industry in West Africa is not as well developed in general as in North Africa. Of the 17 countries in this region, it appears that 10 have no existing steelworks, and no plans whatsoever for developing them within the foreseeable future.

It has not been possible to obtain information from Dahomey, Mali, Niger, Spanish Sahara, or Portuguese Guinea, but conditions in these countries are such that there is unlikely to be any prospect of steelworks developments. In Sierra Leone, the 2.5 million population is engaged mainly in agriculture, and their industry is at such an early stage of development that there are no current proposals for a steelworks project, and none foreseen for a considerable time; the position is similar in the Gambia, where the population is only half a million. In Togo and the Upper Volta there is no steel industry; the only plans are for a small foundry for iron or steel castings in the latter, and a small rolling mill and foundry in Togo. Both these projects are at a very early stage of consideration, with no details finalised yet. Finally, in the Cameroons some small rolling mills already exist, but no expansion programme is envisaged since there are neither iron nor coal deposits available in economic quantities in this country.

Three countries in this region have no steel industry at present, but do have some plans for development. In Guinea, there are large proved reserves of high quality iron ore, which is being exported, and there are very tentative plans to establish an iron and steelworks at Conakry, of half a million tons capacity, some time during this decade; no detailed plans have been made. In Mauritania an ambitious project for a 400,000 ton integrated steel plant at Port Etienne was outlined as early as 1964. They have large iron ore deposits, but a very small home market for steel products and considerable problems over the supply of electricity and water - a de-salination unit would be necessary; thus the project is unlikely to be realised during this decade. The plans in Senegal envisage a small semi-integrated works to be constructed over the next four years, with the intention of exporting most of the products to Mali. Total production would be around 25,000 tons per year of crude steel, with a 70,000 ton rolling mill capacity. Of these three projects, only the Senegalese works is likely to materialise during the decade, and then only if an outlet to Mali can be definitely established, since their home market alone would not justify it. It would, however, be difficult to win this export market, in the face of competition from Nigeria and the Ivory Coast; thus there must be considerable doubt whether Senegal's project will go ahead.

Finally, there are four countries which already have small steel industries and some development plans - Ghana, Ivory Coast, Liberia and Nigeria. There is considerable scope for them to co-operate over steelworks development in view of the rather restricted size of their individual home markets, and in 1967 a study was carried out on this basis, which has been detailed below under Liberia. The Nigerians were not prepared to consider co-operation at that time, and have their own development programme. Ghana have been considering for some years extending their steel plant at Tema, which produces around 30,000 tons of merchant steel and reinforcing rods per year from ships' scrap, to a level around 100,000 tons per year. The state of progress on this proposal is not known. There is a small steel industry developing in Ivory Coast which consists at present only of rolling mills, but electric steelmaking is being introduced between 1971 and 1975. Even by 1980, however, total capacity will only be around 160,000 tons per year. Local iron ore deposits in Ivory Coast are also being developed.

Liberia

The Liberians have no iron and steel industry of their own, but plans were drawn up in 1967 to establish an integrated steelworks to serve the whole of the West African sub-region. It was assumed that the markets in Nigeria and the Niger would be supplied by the steelworks planned for Nigeria, and that the net market in West Africa open to a Liberian steelworks would be 400,000 tons per year in 1975. The plant was, therefore, planned to produce about 200,000 tons per year initially, using one 15 foot blast furnace and two LD converters; output would eventually rise to over half a million tons per year. Nothing has yet been done towards the implementation of these plans, which would have been based on the availability of high quality local ore which is at present only exported; there is also a local pelletising plant, which is planned to produce some 2 million tons per year in 1971. Financial arrangements were to have been shared between the participating countries; the capital cost was estimated in 1967 to be of the order of $115 million over the first ten years.

Nigeria

Nigeria is a country with substantial reserves of coal as well as iron ore (although the latter is not of such good quality as, for example, in Mauritania). Further, Nigeria alone probably accounts for as much as 50% of the total market for steel products in West Africa. As yet there is no integrated steel industry in the country, although there have been ambitious plans to establish such an industry. The latest official plans as set out in the official Second National Development Plan (1970 - 1974) call for the establishment of a 750,000 tons per year integrated works, construction of which is scheduled to start in 1974. Total cost is expected to be £150 million (Sterling). This plan will probably go ahead in due course possibly with Soviet technical and financial assistance.

Plans for semi-integrated steelworks have also been noted by the private sector in particular by Korf. These plans are shown on the schedule, but if the State plans for an integrated works are given the go-ahead, it is unlikely that permission will also be granted for the private sector proposals.

Finally, there is a very small semi-integrated steelworks, Nigersteel Company at Enugu, based on local scrap; plans for rehabilitation and for expansion, following the civil war, are under consideration. Output before the war was about 10,000 tons per year.

2.3 Central Africa

General

Half the eight countries in this region have no existing steel industry, and no plans to establish one. Information from the Central African Republic and Chad was not available, but the circumstances in these two countries preclude any steel works development. Information from Malawi confirmed that they have no steel industry, and no development plans, and in Swaziland the only proposal is to beneficiate the lower grades of ore which they are currently exporting at a rate of 2.5 million tons per year.

Of the other four countries, only Angola and Zambia have any steel works at present, although in Zambia this consists only of small galvanised sheet and welded pipe plants. Both countries have plans to construct integrated steelworks, as do the Congo Republic (Kinshasa) and Mozambique; details are given below. The development of steel demand in these countries should justify these projects, in view of their restricted objectives; development of large-scale steelworks cannot be expected in the immediate future, however, with the possible exception of Angola where the potential for future industrial development to match their large material resources is considerable.

Angola

Angola's iron and steel industry was established in 1965 with the opening of the first part of an integrated industry producing pig iron and crude steel. These works are based on different sites, but together form an integrated industry. There are now plans to extend the works to raise crude steel capacity to around 120,000 tons per year, and it is believed that a start has already been made on the implementation of this expansion programme.

Congo (Kinshasa)

There are plans to establish an integrated steel industry at Maluku, with Italian assistance, based initially upon scrap, but later to become integrated utilising local iron ore. It is planned for the works to come on stream in 1972/73 with a capacity of around 150,000 tons, and for this to be raised progressively to 300,000 tons. Demag are installing a 50 ton electric arc furnace which will rely for power on the hydro-electric scheme at Inga; a 4 strand Conticast plant and light section mill are also being installed. Italimpianti are installing a CR strip mill.

There are also Congolese plans to establish a steelworks at Kimpako near Kinshasa, but no recent news has been released on the progress of this plant.

Mozambique

Mozambique has had plans for some years to develop an integrated iron and steel industry at Beira to exploit local coal and iron ore. The latest proposal is by Companhia de Uranio de Mozambique, who are planning a 250,000 ton plant to produce mainly for export. The tentative implementation date is 1974, but no start has been made on the project as yet.

Zambia

The Zambian Industrial Development Corporation (Indeco) has plans to construct an integrated steelworks at Kafue near Lusaka to utilise local available coal; the plans envisage a plant of around 60,000 tons per year initially, costing approximately $25 million. The plans include introduction of pig iron, steel ingots and approximately 50,000 tons of rolled products. Start-up is provisionally scheduled for 1974, and initial orders for equipment are expected to be placed during 1971.

2.4 East Africa

General

This region has been taken to include Mauritius and the Malagasy Republic, and thus consists of nine countries. Of these, only four countries have any significant steelworks projects. There is no steel industry in any of the remaining five countries, with the exception of Mauritius and Somalia; the former have only a 6,000 tons per year rerolling mill, for which there are plans to install a small electric arc furnace to melt local scrap, while in Somalia such a semi-integrated works already exists, with an annual capacity of 6,000 tons. Burundi have no steel industry and no plans to establish one, and it is assumed that the situation is the same in Rwanda, although no definite information is available. In the Malagasy Republic, however, studies have been made for a rolling mill project to be based either on imported billets or on scrap melting; these studies have been suspended in view of the small market, and will not be revived unless a more economic process allowing price reductions of the finished products should become available.

Ethiopia, Kenya, Tanzania and Uganda can to some extent be considered en bloc, and indeed a feasibility study for the development of the steel industry in East and Central Africa (covering Malawi, Rhodesia and Zambia, in addition to the nine countries in East Africa) was carried out on behalf of the United

Nations Economic Commission for Africa in 1965. Consumption of iron and steel products at that date was about 450,000 tons per year, of which only 75,000 tons was produced in the region - principally in Ethiopia, Rhodesia and Uganda. Excluding Rhodesia, consumption in 1965 was about 300,000 tons for the whole region, and was expected to rise to 400,000 tons by 1970 and 600,000 tons by 1980. This level of demand is sufficient to justify the development of an integrated steelworks to serve this region. There have been no further developments, however, towards a multi-national project of this kind.

Ethiopia

Steel industry developments in Ethiopia are on a very small scale, with a scrap based plant at Akaki producing at a rate of around 5,000 tons per year and a small galvanising plant.

There were reports some years ago of plans for a major steelworks at Sebeta, but these appear to have fallen through. There are also plans to install steel-making capacity at Akaki of as much as 80,000 tons per year at a cost of around $ Ethiopian 50 million; so far, this has not gone further than the planning stage.

Kenya

Kenya's iron ore and coal reserves are not easily exploitable for steel-making; the two basic steelmaking raw materials have therefore to be imported, as does scrap which is not available in large quantities. The market is expanding quite rapidly, and is now at approximately 100,000 tons per year (84,000 tons per year in 1966).

There are three main producing companies, Kenyan Sheet Manufacturing Co. Ltd. with a 25,000 tons per year galvanised sheet plant at Changamwa and a corrugating plant at Shimagi; EMCO Steelworks Kenya Ltd. at Nairobi; and KUSCO, which started as an expansion of East African Wire Industries Ltd. in collaboration with Development Finance of Kenya Ltd. Both EMCO and KUSCO have expansion plans, envisaging the installation of electric arc steelmaking of approximately 100,000 tons capacity, the former by 1972 and the latter by 1980.

However, it is probable that expansion to this level of capacity will not go ahead much before 1980, in view of the market size, although Kenya envisages exporting much of the output to Ethiopia and Zambia.

The Kenyan Aluminium Works Ltd. have been thinking of installing a merchant bar mill of 60,000 tons per year capacity, but this project does not seem to be progressing.

Tanzania

The United Republic of Tanzania has 130 m. tons of proved iron ore reserves, and 200 m. tons of coal, part of which is coking coal. The location of the deposits is the Livingstone Mountains between the towns of Sonjea and Njombe.

A very ambitious project was approved, of which the first phase requires an investment of 5.7 million Shs. for the mining of the iron and coal deposits. The complete project includes an iron and steel works, the exploitation of the mines on a large scale, the building of a power station, and the construction of a whole village for 30,000 people. The total investment would be 3 000 million Shs., and the project will be co-ordinated with the Tanzania Railway project.

The existing steel producers are re-rollers - Matabi Ltd., a galvanised steel plant at Dar-es-Salaam of 25,000 tons capacity, and the National Steel Rolling Mill at Tanga of 10,000 tons per year capacity of bars and sections. Neither of them have integration plans.

Present consumption is about 65,000 tons per year of rolled steel; it is forecast that consumption will be 150,000 tons per year by 1976. It is, therefore, possible that the ores will be beneficiated by the end of the decade, and a small integrated plant producing semis will probably be constructed.

Uganda

Iron ore known reserves in Uganda amount to about 100 million tons. Magnetite deposits at Sukuka which have 45 million tons of proven reserves are sufficient for economic steel production. The iron content of the ore is 62%. Coking coal is not available in substantial quantities in Uganda, and would, therefore, have to be imported.

There are two steel companies in Uganda producing galvanised sheet - the Uganda Boati Company (25,000 t.p.y. capacity) and Uganda Steel Company (15,000 t.p.y. capacity) - and also a semi-integrated steel company, Steel Corporation of East Africa, which owns a 12-ton arc furnace and a rolling mill of 24,000 t.p.y. capacity, both situated at Jinja. No details are available of any expansion plans for these companies, but the Uganda Development Corporation have a project for a 100,000 tons per year integrated steelworks, to be completed by 1980, with the steelmaking plant for billet production installed in the early 70's.

2.5 South America

General

The steel industry in South America has been developing for thirty years and in the case of Brazil dates back to 1921. Production has been higher in this region than any other, and consumption very similar to Asia - the proportion of steel consumption covered by local production has, therefore, been considerably higher than elsewhere in the developing world.

Of the six countries in this region who already have integrated steelworks, Brazil and Argentina produce over half the total crude steel output. In Brazil there are 11 integrated and 30 semi-integrated steelworks with a total capacity of over 5 million tons per year, compared with the 2.4 million tons in Argentina. There is a National Plan to raise output in Brazil to 20 million tons per year by 1980. All major projects are under way, and although this ambitious target may not be reached, capacity will undoubtedly rise substantially during the decade, based on the three major state-owned companies who together account for 3 million tons of the current crude steel production.

The steel industry in Argentina is based on three integrated plants, although there are eight steelworks with existing capacity in excess of 100,000 tons of crude steel, and a ninth which is expanding capacity to this level. All these plants have expansion plans, and if they all materialise, the total capacity will reach approximately 7 million tons by 1975; the growth of steel consumption will not match such an increase, and it is unlikely that these plans will in fact all be implemented. Priority is likely to be given to the largest plant - Sociedad Mixta

Siderurgica Argentina (SOMISA) - and even the plans of the other large plant - Propulsora Siderurgica SA - may be curtailed by SOMISA's expansion programme which envisages a capacity of 4 million tons during the decade.

Apart from Brazil and Argentina, there are well developed steel industries in Chile, Colombia, Peru and Venezuela. The last two have plans which would increase their capacity to more than 5 million and 10 million tons respectively, by the introduction of new integrated steel plants. In both cases, the output would have to be exported, and there is considerable doubt whether the new works will in fact be built during this decade; on the other hand, their existing integrated steelworks are likely to increase their capacity to 500,000 tons in Peru, and 1.5 million tons in Venezuela, by 1975, rising to between 2.5 and 3.0 million by 1980.

Chile and Colombia - the remaining two countries with integrated steelworks at present - have, by comparison, more modest proposals whereby Chile's state-owned integrated works will increase capacity to 1 million tons in 1974 and 2 million tons in 1976, while Colombia's Acerias Paz del Rio will increase capacity to 500,000 tons of crude steel. In addition, Colombia has plans to build three new works, of which one would produce 300,000 tons per year, and the other two rather less; the total crude steel capacity might thus approach 1 million tons by 1980, which will be matched by the expected growth in domestic steel consumption.

The remaining countries in South America - Bolivia, Ecuador, Paraguay and Uruguay - do not currently have integrated steelworks of 100,000 tons capacity, nor any definite plans to develop them. Ecuador has a low consumption of steel and a shortage of raw materials, as does Uruguay, and Paraguay's consumption is minimal at 54,500 tons forecast for 1980. Plans for integrated works are, therefore, not justified and any prospects of developing semi-integrated works are also strictly limited - one company in Ecuador is building an electric arc furnace to produce 40,000 tons per year. Only in Bolivia are there plans to develop an integrated works; this would use pellets produced from their considerable iron ore deposits at Mutun and would transport their products output by the Paraguay river. This project would be on a multi-national basis, also involving Argentina, Brazil, Paraguay and Uruguay, but it is very much a long term project which is unlikely to be realised in this decade, in view of Bolivia's restricted domestic market of some 50,000 tons per year. In Guyana, French Guiana and Surinam, there are no known projects and no existing steel industry.

Argentina

The whole of the Argentinian steel industry is based on three companies, Sociedad Mixta Siderurgica Argentina (SOMISA), Propulsora Siderurgica SA and Altos Hornos Zapla, which are the only fully integrated works operating in Argentina. The first two were set up mainly to supply semi-integrated works and re-rollers with semis, and also to substitute imports mainly of flat products. Propulsora Siderurgica will only be allowed to expand if imports of steel products continue to be necessary to satisfy domestic demand, after SOMISA's projected expansion by 4.0 million tons per year; this might well, therefore, curtail the expansion programme of Propulsora Siderurgica. Altos Hornos Zapla does not have any expansion projects planned for implementation in the near future, and is not well placed for further expansion due to the remoteness of its plant from the home market areas. Thus, only two major development plans are under way, with some doubt as to whether part of Propulsora Siderurgica's expansion will be substituted by a further expansion at SOMISA. The remaining plans are those of special steel firms which intend to modernise their equipment or integrate or semi-integrate their production. Tonnages involved in these projects are small compared with the two principal projects, because they relate to quality steels. Expansion projects with capacities under 100,000 tons per year were not considered, although in some cases they could very well be of great importance if the type of alloy steel is unusual.

Raw material deposits are also being developed to supply the steel industry with more suitable raw materials. It is planned to have a pelletising plant for the Iron Ore Deposits at Sierra Grande, which would substitute some of the ore imported by SOMISA from Brazil or Peru; SOMISA is also planning a sintering plant to be supplied either with Argentinian ore or imported ore. Coking coal is not to be found in Argentina, but the coal at Rio Turbio can be blended with coking coal to produce coke. The present ratio is 15%, although it is possible that a 25% or 35% ratio could be used. Scrap availability is not a problem, due to the vast amount of old scrap generated during the past years, and the potential availability from old railway material. Common ferro-alloys are currently produced in acceptable quantities within Argentina, the less common alloys being imported with gradual substitution by home production. Limestone is produced wholly in Argentina, as is Dolomite to a great extent, the balance being provided by imports from Uruguay.

Brazil

In 1970 there were 11 integrated steelworks, 30 semi-integrated works and about 89 other works in the Brazilian steel industry. The five biggest plants produce 66% of the total steel output, which is currently some 5.4 million tons per year of crude steel. The known expansion plans of the three major steelworks will increase their capacity to over 6 million tons by 1975, and over 10 million tons by 1980. There are a further three plants who plan to expand capacity to more than 250,000 tons each, while the remaining eight plants with expansion plans will all remain in the 100,000 to 200,000 tons range of crude steel capacity. If these plans are all implemented, they will total approximately 12 million tons of crude steel capacity. On this basis, the total capacity in Brazil by 1980 is likely to reach some 17 million tons, rather than the 20 million tons per year target of the National Plan.

Iron ore is produced at the Ferriferous Quadrangle deposits (Minas Gerais) where reserves have been estimated at 40,000 million tons or 8% of the world's known reserves. Large deposits have also newly been discovered in the northern Carajas Mountains, in the Amazon region, which are supposed to be as rich as those in the Ferriferous Quadrangle. There is a third ferriferous formation in the western state of Mato Grosso, which does not seem to offer possibilities of immediate exploitation due to the distance from the Atlantic coast (2,000 Km). This availability of iron ore in Brazil makes it ideal for steel production, particularly in Minas Gerais and coastal districts nearby. In the Amazon valley, Manaus is a potential site for a steelworks once the steel market develops.

Other raw materials are not so abundant as iron ore - coal must be blended with imported coking coal to produce coke, and the main source for imported coking coal is the U.S.A. Natural gas is available at some of the steelworks sites such as Bahia and Salvador, which might lead to the development of Direct Reduction processes, at an advantage over the conventional steelmaking process.

The National Plan set up to develop the steel industry has been based on work done by the Brazilian Steel Institute (Conselho Consultivo da Industria Siderurgica), Tecnometal (Estudos e Projectos Industriais S.A.), and the three state-owned companies. Although the target is high and may not be reached, it should set the pace and will probably give rise to high growth rates. All major projects appear to be under way after agreement was reached between the Government and international financial organisations.

Market studies are being carried out by Tecnometal to support the Plan, although the go-ahead has been given in advance of the results of the survey, on the assumption that the rates of market growth used in the Development Plan were on the low side. This assumption has been made in spite of the forecasts of an American firm of consultants, whose figures were even lower and were considered too pessimistic by the Brazilians. It is thus very possible that the targets set by the National Plan will not be reached, although this would in itself only lead to postponement of some of the projects, or to temporary exports of steel products to other South American countries.

Chile

The only integrated works in Chile is the State-run steel company CAP (Compania de Acero del Pacifico). There are also semi-integrated privately-run works such as FAMAE (Fabrica y Maestranzas del Ejercito) and others whose total capacity is only 35,000 tons; their expansion projects have not therefore been considered. Chile also produces 15,000 tons of casting and 30,000 tons of forgings for the mining industry and the railways.

Raw materials are available locally, with promising deposits of iron ore in the northern part of Chile. Much of the Chilean investment plans relates to iron ore, in the form of pelletising plants - a 5 m.t.p.y. pelletising plant is planned at the Algatobo mines, and Bethlehem Chile is also planning a 4.5 million tons per year pelletising plant.

The Chilean Steel Market has been expanding at a rate of 6.6% per year on average during the past years. Apparent consumption has been forecast at a level of about 800,000 tons per year in 1975, and about a million tons per year in 1980. Exports have been going down lately due to increased internal consumption, and are presently running at a level of about 20,000 tons per year. The CAP has expansion plans to increase crude steel capacity to 1 million tons by 1974, with a second phase expansion to 2 million tons by 1976. The first stage is in progress, but in view of the market forecasts outlined above, it is probable that the second stage of the expansion plan will be postponed.

Colombia

There are 5 steel companies in Colombia, of which three are integrated or semi-integrated. The semi-integrated works are Empresa Siderurgica SA (Medellin), with a 22,000 tons per year capacity electric arc furnace, and Siderurgica del Pacifico SA with a 31,000 tons per year electric arc furnace.

Colombia's Instituto de Fomento Industrial and the Instituto de Investigaciones Tecnologicas were considering the construction of a $280 million steelworks with a capacity of some 1 m.t.p.y., taking into consideration the possibility of obtaining the necessary coal supplies from Cerrejon and Palmarito deposits. This plan seems to have been substituted by an alternative project for three works, one to be an integrated works at Tibate near Medellin, the second an iron and steel works at Barranquilla (a harbour in the north of the country) with a capacity of 100,000 tons of plates a year, and the third an iron and steel works with a capacity of 100,000 tons of steel per year at Sinacura (near Bogota). Details of these three works are not known because they are at a very early planning stage.

Raw steel apparent consumption was 575,000 tons in 1968, of which 46% (240,000 tons) was produced in Colombia. Growth of ingot equivalent has been 5% yearly (4½% for bar products, 4% for flat products, and 9% for seamless tubes). Some 90% of the steel produced within Colombia was produced by the integrated works of Acerias Paz del Rio.

The second development plan is quite likely to go ahead, since it will do no more than increase domestic production to cover the growth in domestic consumption, and at the same time increase its share of the domestic market, without any risk of overproduction. It is probable that some of the new works will be state-owned - all of the existing works are privately owned.

Peru

There is only one integrated works in Peru - SOGESA (Sociedad Siderurgica de Chimbote SA) - but there are several re-rollers with steelmaking capacities ranging up to 40,000 tons per year. The biggest of these, Acero Peruano (APESA) has semi-integration in mind, with plans to build an electric-arc furnace of 40,000 tons per year capacity.

Iron ore of good quality is found in various places in Peru along the Andes mountains. The principal deposits are located at Marcona and Acari. The Marcona Mining Company produces 8.8 million tons per year of iron ore, and has obtained a government agreement to increase production to 10.5 million tons; its pelletising plant - the only one in South America - will increase its capacity to 3.3 m.t.p.y. in the early 70's. Coking coal is also available in Peru, and Hydroelectric power is easily available from power stations, taking advantage of the level differences in the Andes rivers.

Apparent consumption of finished steel products expressed in ingot equivalent was estimated at 367,000 tons in 1970. The various forecasts on future consumption indicate a level between 500,000 and 600,000 tons per year by 1980.

SOGESA intend to expand their capacity to 500,000 tons of crude steel; this is likely to take place, since the market will require this expanded capacity by 1980. There is also a project for a new steelworks at Marcona, utilising the iron ore pellets to manufacture 1.5 million tons of crude steel by 1976, rising to 3 million by 1978 and 5 million by 1980. The prospects for these plans are less certain, in view of the distances to the centres of steel consumption, since revenues are unlikely to cover the cost of transportation involved in exporting the products.

Venezuela

[illegible]
(SIDOR), whose current crude steel capacity is 750,000 tons per year. They plan to expand this to 1.5 million tons by 1975, and between 2.5 and 3.0 million by 1980. Hot and cold rolled mills, a sheet mill, tinning line, and centrifugal tube casting are also being installed. Products will be merchant bars, structural steel, seamless tubes and flat products.

Iron ore is found locally at the iron belt in the Imataca formation. The Bolivar Iron Quadrilateral within the belt accounts for most of the Venezuela production of some 17 million tons a year. New deposits within the Quadrilateral are being developed at S. Isidro to produce 5.0 million tons a year. Known reserves of the belt are estimated at 2,000 million. Two major companies exploit the deposits, the Orinoco Mining Company which is building a 1.0 million tons per year briquette plant producing 85% constant Fe briquettes, and the Marcona Company. Coking coal is not available in acceptable quantities within Venezuela, and coke is therefore imported. Hydroelectrical potential is 10 million Kw, of which 1.0 million Kw are under exploitation; natural gas will be available from the Aroca area at a daily rate of 4.2 million m3. Home consumption of steel products was 1.3 million tons of ingot equivalent in 1970; it has been rising steadily in the past years, and is likely to reach 1.8 million by 1980. Exports were 300,000 tons in 1970, and are likely to be in the half million region by 1980. This gives considerable scope for the SIDOR expansion plans, when it is considered that there are only two other steel producers in Venezuela of any importance - Siderurgica Venezualana SA (Caracas) SIVENSA, a semi-integrated works of 120,000 tons per year capacity producing wire, spun pipe, merchant bars and wire rods, and SIDEROCA a bar re-roller which is installing a 100,000 tons per year capacity bar mill.

There are also plans for two new steelworks - a $1,000 million project - based on the assumption that profits could be generated to the Venezualan economy by selling the 17 million tons per year iron ore production in the form of semi-finished products on the world market. The generation of foreign currency would help to finance the project to the extent of paying for half the investment - the other half would be sought elsewhere. This project seems over-optimistic, and is most unlikely to be implemented during this decade.

2.6 Central American Area

General

This region has been taken to include the whole of Central America, Mexico and the countries of the Caribbean.

Of these three areas, only Mexico has a substantial steel industry including integrated plants, with a production in 1968 of 3.4 million tons. This was marginally below their apparent steel consumption; thus, Mexico has almost reached self-sufficiency, and already exports about 177,000 tons. The expansion planned for this decade would more than double their capacity, which will necessitate an increase in their exports, since home consumption will not quite keep pace with this rate of increase.

In Central America, there are currently no integrated steelworks, but several projects for plants of the scale of 100,000 tons per year or more are under consideration. In the Caribbean countries, however, there are no steelworks and no plans to establish them in the foreseeable future, with the sole exception of Cuba, where the possibility of developing a steel industry is currently under consideration.

Central America

The countries included in this area are those of the Central American Common Market - Guatemala, Honduras, El Salvador, Nicaragua and Costa Rica - as well as Panama and British Honduras.

Iron ore is found only at Agalteca (Honduras) in the form of hematite, with estimated reserves of 6 - 10 million tons, and on the Pacific Coast of Costa Rica, where magnetite TiO_2 bearing sands have been discovered, which can be concentrated and used for steelmaking in this form. Proved reserves have been measured to contain an iron equivalent of 4.5 million tons. Charcoal can be obtained in both regions from the forests near the iron ore deposits. Limestone is potentially available near both deposits.

During 1968 a study was carried out to investigate the possibilities for integrated steelworks in Honduras and Costa Rica. The market considered was the existing re-rollers' future requirements of semis, and the future use of finished rolled products by the countries of the area. The conclusion reached was that the potential steel works should mainly concentrate on billet production with some emphasis on bars which would be produced at a later phase, following the market's development. The trends over the past years in the apparent consumption of steel in the countries of the Central American Common Market are shown below:

	1955	1960	1965	1968
Costa Rica	43,944	36,513	70,701	n.a.
El Salvador	26,254	25,302	55,960	"
Guatemala	27,113	44,608	79,468	"
Honduras	22,055	13,721	32,043	".
Nicaragua	27,265	20,479	48,932	"
Total	146,632	140,623	287,094	

There are also figures available for the whole of Central America including Panama; these are not comparable with the above, but are shown below:

Total + Panama	-	127,900	228,100	290,000

It should also be possible to export billets from Central America to Haiti and the Dominican Republic.

On the basis of this demand for steel, there is scope for building up to two iron and steel integrated works with an annual capacity of some 100,000 to 150,000 tons per year each. The results of the study mentioned above showed that the Honduras project would be more profitable if complemented with a bar rolling mill. The Costa Rica project did not seem profitable on the basis of the information available at the time; there is, therefore, less probability of it being implemented, although transport costs would be lower than for the Honduras project. Details of both these projects are given in Appendix III.

Information from a leading El Salvador industrialist indicates that an alternative joint project may instead go ahead at Golfo de Fonseca on the Honduras Pacific Coast. It is also likely that a pelletising plant will be built at Agalteca in place of the originally planned steelworks, for which transport would have been a problem in view of its inland site.

Mexico

There are four integrated producers in Mexico. One of them is the state-owned AHMSA, the biggest steel producer in Mexico with 40% of Mexico's total gross production and 60% of the steel. Three out of these four companies produce sponge iron by the HyL process of direct reduction, which is still at its research stage. The total number of steel producers in Mexico is over 50, but the four integrated works produce about 90% of all Mexican steel.

The main steelworks are situated in the northern region of the country, near the most important coal belt, that of Coahila, relatively distant from the iron ore deposits. New installations such as the plant of Hoja y Lamina at Puebla, and the Tubos de Acero de Mexico plant at Veracruz, are relatively close to their consumer markets and very distant from the iron ore deposits from which they are supplied (El Encino, Jalisco). The greater part of the semi-integrated and non-integrated works are situated near the consumer markets in the Distrito Federal and in the Estado de Mexico. The policy followed by Mexico of locating integrated works at a distance from their iron ore deposits - the opposite policy to that followed by other countries - appears to be due to a defective railway tariff structure which subsidises the transport of iron ore, and penalises that of finished products. This policy leads inevitably to loss of efficiency in the steel industry as a whole. There are some signs of change, such as the possible location of a new steelworks at Las Truchas, near the iron ore deposits. This project is understood to be under active consideration. Pending government approval, the only information available is that, if approved, it will be an integrated steel plant consisting of a pelletising plant, two blast furnaces, BOF steel converters, equipment for continuous casting and continuous rolling mills. The plant would be built in two phases: the first one for a capacity of

1.5 million tons of steel, and the second for a similar additional capacity. It would use the iron ore deposits at Las Truchas, near the Pacific Coast, and near the mouth of the Balsas River.

A brief study of the Mexican market for steel rolled products indicates that Mexico has practically reached self-sufficiency. Apparent consumption, expressed in ingot equivalents, was 3.47 million tons in 1968 against production of 3.43 million tons. Imports and exports were running at the rate of 224,000 tons and 177,000 tons respectively; imports are now lower than they were in 1953 by approximately 30%.

Current expansion programmes are only likely to go ahead if they are planned to meet future consumption in the home market, plus a reasonable increase in exports. All major companies envisage more than doubling productive capacity by 1980. This would necessarily outstrip growth in home consumption, especially when it is considered that as the industry matures, utilisation rates of installed capacity will increase with more efficient production. It is therefore likely that 1980 target capacities will have to be reduced if exports do not increase substantially during the next decade.

2.7 Middle East

General

There are six countries in the Middle East which have existing integrated plants of 100,000 tons plus capacity, or plans to introduce such steelworks - Egypt, Iran, Israel, Kuwait, Saudi Arabia and Syria. Of these, only Egypt and Iran have definitive plans to expand their steelmaking capacity during this decade.

Israel have one plant with a capacity of 125,000 tons per year - Israeli Steel Mills Ltd. - and a smaller plant of 25,000 tons; they do not, however, have any plans for further integrated steel plants.

There are plans in Kuwait for a 100,000 tons per year mini steel plant, which would be scrap based with continuous casting and rolling mill for producing reinforcement rods of maximum 30-32 mm diameter. A feasibility study for this project has been completed, but no firm decision to go ahead appears to have been made.

In Syria also, there are plans to set up an integrated works, and a feasibility study for this project is currently in progress with assistance from India; the order of magnitude is understood to be in the $100 million region.

In the rest of the Middle East there are rolling mill facilities, but no integrated plants nor plans to introduce them. In the Lebanon there are some scrap-melting facilities. No information is available for the Yemen, and it appears that there are no plans to construct steelworks in the Trucial States, Bahrain, Qatar, or the Sultanate of Oman.

Egypt

The steel industry in Egypt is entirely state-owned, and in 1969 had an annual capacity of 500,000 tons of crude steel. Iron and steel are made at five plants, of which the largest is the integrated plant at Helwan, the Egyptian Iron Steel Co., which had a capacity in 1969 of 300,000 tons of crude steel and rolled products, and 200,000 tons of pig iron. Three of the other plants have steelmaking capacity in the region of 50,000 tons per year, based on open hearth or electric arc furnaces, while the fourth is a welded tube plant.

The Delta Steel Mill does not appear to have any expansion plans, but the other two - National Metal Industries and Egyptian Copper Works - propose to increase capacity by the addition of electric arc furnaces and continuous casting machines, to 160,000 tons and 150,000 tons respectively. The bulk of Egypt's expansion plans, however, will be centred on the Helwan Steelworks, where new equipment includes a third blast furnace (650,000 tons per year), two 100-ton basic oxygen converters, continuous casting plant and galvanizing facilities. These are planned to raise capacity to 850,000 tons on the introduction of the third blast furnace, and 1.5 to 2.0 million tons on completion of the fourth blast furnace. The iron ore will be supplied by rail from their mines at Baharia.

The expansion plans indicated above will enable Egypt to meet her entire domestic steel consumption, with a surplus for export of up to 500,000 tons.

Iran

There is no steelmaking capacity in Iran, but their first integrated steelworks, the National Iranian Steel Company, is currently under construction with Soviet technological assistance, and is due to come into operation by the end of 1971. The initial raw steel capacity will be 700,000 tons per year, rising to 1.4 million tons within two years. The first blast furnace will have a daily capacity of 1,500 tons, and steelmaking will be carried out by two 100-ton LD converters, which will be supplied by Dnepropetrovsk steelworks. The researches of this company indicate a demand for steel rising to 3 million tons per year in 1975, from the present figure of 1.4 million tons; such a rise would more than cover the output of their new integrated plant.

Iranian Rolling Mills also have plans to expand their total rolled steel output to 0.5 million tons per year by 1973, and to install steelmaking facilities in their associated company, the Sharian Steel Plant Co. at Ahwaz. The latter have ordered two 50-ton electric furnaces and a 4-strand continuous casting machine for 90-130 mm^2 billets. If the activities of these two plants are considered together, they will form an integrated complex with a crude steel capacity of approximately 200,000 tons per year.

Saudi Arabia

The General Petroleum and Mineral Organisation has a steel rolling mill at Djeddah with 45,000 t.p.y. capacity. They intend to install a billet mill, and in due course, iron and steelmaking capacity. Detailed plans have not been agreed to date, but the alternatives foreseen are an electric arc furnace based on imported scrap, or a direct reduction process to utilise the large local deposits of hematitic ores.

2.8 Far East

General

In this area, there are only four countries whose steel industry currently includes any plants with a capacity in excess of 100,000 tons of crude steel - South Korea, Taiwan, Singapore and Malaysia. In all these countries, there are plans either to expand the facilities of existing works, or to set up a new integrated steel plant. South Korea already have the largest output of crude steel in the area - over 500,000 tons in 1970. They also have a new integrated plant under construction, which will have an output of 1 million tons of raw steel by 1973, in addition to expansion plans for their existing plants. Malaysia's only major company also has an expansion programme currently in progress, whereas expansion plans in Singapore have not yet been finalised. In Taiwan, a decision to build a new integrated plant has been made and detailed plans drawn up, but construction has not yet begun pending finalisation of the plans, particularly in respect of financing arrangements.

Apart from these four countries, the Philippines and Thailand also have well established steel industries, although they do not at present have a large integrated steelworks. Both countries, however, have firm plans to expand existing plants considerably over the 100,000 tons level, and perhaps to invest in new integrated steelworks.

No other country in this area is likely to develop a 100,000 tons integrated plant in this decade, although Burma and Hong Kong have steelworks with capacities in the region of 25,000 tons per year, and are known to have expansion plans. In Indonesia, there is a partly finished 100,000 tons steel plant at Tjilegon, which was under construction by the USSR; the recent plans of Granite City Steel of the USA to complete this plant have been abandoned. There are reports of a project for the construction of an entirely new integrated plant, to be completed in 1972, but details are not available. In South Vietnam, there are a number of steelworks projects, largely based on steel scrap. The biggest of these will produce 30,000 tons per year of coiled rod, and the total output of the four works for which details are available will be 70,000 tons. In Cambodia and Laos, there are no substantial steelworks.

The current demand for steel in the Far East is at such a level that all these projects are viable in terms of marketing the steel products. In each case the domestic market would absorb the increased output, and still require imports - which are principally from Japan.

There have been some developments towards international co-operation in the area, with the recent establishment of the South East Asia Iron and Steel Institute, whose members are Australia, Indonesia, Japan, Malaysia, Philippines, Singapore, Taiwan and Thailand. This Institute should in due course provide comprehensive statistics on the steel industry in this area.

Korea (South)

The total raw steel capacity in Korea in 1969 was 513,000 tons, which will be trebled by the new integrated steel plant currently under construction at Pohang City in South East Korea. The output of the Pohang Iron and Steel Company will be 950,000 tons of pig iron, 1.01 m. tons of raw steel, and 925,000 tons of rolled steel; this will bring the total capacity in Korea more into balance, the new figures being 1.0 m. tons of pig iron, 1.5 m. tons of raw steel, and 1.7 m. of rolled steel. The raw material requirements of the Pohang Works will be met partially from domestic sources, although 70% of the iron ore (approximately 700,000 tons) and 300,000 tons of coal will be imported via the local harbour, which will accommodate vessels of 50,000 tons and, in future, of 80,000 tons.

The demand for steel in Korea has been increasing at well over 20% per year over the last ten years, with imports running at between 100,000 and 200,000 metric tons per year. The objective of the new integrated works is to meet this home demand, and no exports are currently envisaged. The project is being financed and technically assisted principally by Japanese, Austrian and Australian concerns, with a total foreign investment of $163 million; in addition, the Korean Government and other domestic sources will provide local currency equivalent to $125 million.

There have been reports that an existing Korean steel company, Inchon Heavy Industries, has plans to increase their current 100,000 tons output of raw steel to 200,000 tons in the near future, and in due course to 1 million tons. The time scale is not known, nor are any details available for this project.

Malaysia

The Malayawata Steel Company is the only substantial steelworks in Malaysia;

it is an integrated works with a current capacity of approximately 130,000 short tons of raw steel. A Phase 2 expansion is currently in progress, whereby a second blast furnace was introduced in 1970 which has increased the output of pig iron to 120,000 tons per year. The expansion will be completed by 1972, with the introduction of a 10-ton electric arc furnace, a continuous casting machine, hot coiled processing, and a slitting machine for wide strip. The total steel capacity of the existing two 12-ton LD converters will be increased by the electric arc furnace to 150,000 tons per year. A further Phase 3 expansion is under consideration; no detailed plans have been made, but it is intended to produce steel sheets and tin plates.

The steel industry in Malaysia is also represented by three "mini' mills which have a total combined capacity of approximately 60,000 tons per year.

Philippines

There is a well established steel industry in the Philippines, with five semi-integrated plants and a number of rolling mills. None of the former have a capacity exceeding 100,000 tons, but there are currently three companies with plans to introduce substantial steelmaking capacity. The Iligan Integrated Steel Mills Inc. was started in 1965 with the intention of becoming the Philippines first integrated iron and steel works, with an initial capacity of 350,000 tons of crude steel and 275,000 tons of finished steel. Existing production facilities consist of hot and cold rolling mills, and an electric furnace plant and LD steel shop, to be in operation by 1974, together with continuous casting facilities. The Elizalde Rolling Mills Inc. also have proposals for a blast furnace plant, LD steel plant and blooming-slabbing mill for implementation in 1972, to produce semis for its own mills and billets for other mills. Finally, the Marsteel Corporation, a smaller company, has plans for a 200,000 tons per year billet mill.

The Philippines Board of Investments is currently considering the viability of these proposals, and also assessing the alternative possibility of setting up a single integrated plant as a co-operative venture, in order to achieve a more economic initial capacity of 1.5 million ingot tons per year. Such a scheme would involve two blast furnaces for producing 2,500 tons of pig iron each per day, and converting this to steel in LD converters; billets would be produced by continuous casting, and a slabbing mill would be installed to roll ingots into slabs for processing by the two hot rolling mills recently approved - one of which is already installed. Decisions on these alternative proposals will shortly be made.

Singapore

The National Iron and Steel Mills, who operate two electric arc furnaces of 120,000 tons total capacity, are the only large steelmaking company in Singapore. Their expansion plans will introduce a 40-ton (x20 MVA) electric arc furnace raising capacity to 190,000 tons per year. Consideration is also being given to the making of sponge iron by a direct reduction process. Continuous casting machines to produce slabs, large blooms and billets, and increased rolling mill capacity will also be introduced. Almost half their production is currently exported, the remainder being marketed to the local construction industry. The domestic demand for steel is expected to rise by some 15% a year according to an assessment by the Japan External Trade Organisation, although the actual rate of increase may well prove to be rather less than this.

A joint Thai-Singapore project has also been reported, which would locate blast furnaces and melting shop in Singapore utilising iron ore deposits from Thailand and supplying rolling mills in Thailand. The propsects for such a steel plant depend on Thai and Singapore Government authorisation.

Taiwan

There are currently 20 steel companies in Taiwan with an installed ingot capacity of 800,000 tons and output of 700,000 tons of bars, rods and sections per year. All are based on electric arc furnaces. Plans have been under consideration for several years to build a large new integrated steel works and the Economics Minister has recently indicated that this project will definitely go ahead for implementation over the next five years. Preliminary assessment of the feasibility of the project has been made on the basis of a first stage production capacity of 1.3 million tons of crude steel, to be followed by second stage expansion up to 2 million tons per year. Products would initially consist of 300,000 billets, and 800,000 rods, bars and sections, with the addition of flat products in the second stage. Steelmaking would be by two 130-ton basic oxygen furnaces, with a continuous casting plant for billets, a rod and bar mill, and a bar and section mill. Iron ore and coal would be imported to feed one blast furnace of 1.15 million tons per year capacity; however, some consideration may be given to the use of direct reduction processes. Harbour and dock facilities would also have to be provided. Finance would be provided by equity and loans, in the ratio of 1 : 2, the former being largely divided between the Chinese Government (45%) and foreign investors (45%), while the loans would be obtained principally from Japanese sources (25%), suppliers credit (45%), and local banks (20%). Steel consumption in Taiwan has risen by 18% per year since 1950, and is expected to continue to rise at between 6% and 10% to give annual tonnages of 2.15 million in 1975 and 4.12 million in 1985. Existing production is expected to have dropped to 500,000 tons by the time the projected steelworks takes part in the domestic market, thus the output of the new works could be entirely absorbed by the domestic market.

Thailand

The current output in Thailand is 560,000 tons of steel products, largely from imported materials - pig iron production is only 22,000 tons per year. The only integrated steelworks is the Siam Iron and Steel Co. Ltd., which has expansion plans for implementation in four phases. By 1971 the first two phases will be complete, increasing production to 165,000 tons per year of sections, bars and rod with the introduction of a merchant and bar mill; the third and fourth phase to be completed in 1976 and 1978 respectively, will increase their total capacity to 230,000 tons per year of these products. It is reported that two 25-ton electric arc furnaces, plus some LD capacity, will be installed to increase their crude steel output, which is presently provided by an open hearth furnace, an electric arc furnace, and high frequency induction furnaces, with a total capacity of 40,000 tons. It has also been reported that two charcoal blast furnaces, with a capacity of 600 tons per day each, will be installed at some future date.

Plans for a new integrated steelworks have also been discussed for some time and various Thai-Japanese projects are reported to have been submitted to the Board of Investments - who have not supplied any details in this connection. These and other proposals from the USA and Australia, all put forward capacities in the region of half a million tons of products per year; this is thus considered to be the minimum required output of cold rolled products together with a crude steel capacity of 1 million tons in the opinion of the Board of Investments.

In 1968 it was estimated that steel demand would reach 0.9 million tons in 1970, 1.1 million tons in 1975 and 1.7 million in 1985; current needs have already reached 1 million, so that there is likely to be a firm market for the products of Siam Iron & Steel's expansion plans. It is estimated that Thailand will be approaching self-sufficiency in bar production by 1973, with the Siam Iron & Steel expansion, but with total imports in 1969 of over 600,000 tons of steel products, there appears to be room both for their expansion plans and for a new half a million ton integrated steelworks.

2.9 Indian Sub-continent

General

The countries included in this region are Afghanistan, Ceylon, India and Pakistan. These have all been dealt with independently below, in view of the diverse nature of their steel industries, which is virtually non-existent in Afghanistan, small in Ceylon, somewhat larger in Pakistan though with some semi-integrated works, and in India is the largest steel industry in the developing world with the possible exception of Brazil.

In Ceylon, there are plans to introduce steelmaking capacity in the state owned rolling mills, and Pakistani expansion plans will create two integrated steelworks with a combined capacity in excess of one million tons. Thus during this decade, all these countries except Afghanistan will have an integrated steel industry.

In India, production is currently some 5 million tons per year of crude steel, while apparent consumption is 9 million tons rising to 12 million by 1973-4. Their expansion plans are substantial; the state-owned Hindustan Steel Limited have projects for three new steelworks together with expansions at their existing works. The private sector is also planning to expand marginally;

the two main private concerns - Tata Iron and Steel (TISCO) and Indian Iron & Steel (IISCO) - intend to concentrate primarily on the modernisation of their existing plant, but there are many mini-mills projected, with six already in progress.

Afghanistan

The newly discovered iron ore deposits are estimated to hold reserves of some 1,000 to 2,000 million tons of 50% iron ore. Coal reserves are estimated at some 100 million tons. Part of it is coking coal.

There is a very small firm in Afghanistan, Century Re-rolling Mills at Kabul which produces building industry products. Very recently the Pakistan Government has approved plans by a local firm to set up a mini steelworks in Afghanistan. The works will convert scrap to produce some 7,000 t.p.y. of billets of which some 1,000 - 2,000 t.p.y. will be exported to Pakistan. There are also some vague plans to build an integrated steel works to produce steel from Afghanistan's large iron ore reserves - Pakistan had shown some interest in importing ore from Afghanistan, but it now appears more likely that their ore will be imported from Australia instead.

Home consumption can be measured from imports which are now running at the level of some 20,000 tons per year. This figure in itself does not justify the building of an integrated works, and if any such plan went ahead if would be necessary for most of the output to be exported. No integrated works of any importance are therefore likely to be built in Afghanistan in the near future.

Ceylon

Rolled steel production started in Ceylon in 1967 when the Ceylon Steel Corporation started a bar mill at Oruwela with an initial capacity of 40,000 tons per year, to be increased to 60,000 tons per year. Wire drawing capacity is 12,000 tons per year. In addition to the state owned works mentioned above, two privately owned plants for galvanised sheets have been built, with capacities of some 12,000 tons per year and 10,000 tons per year respectively.

Iron ore reserves in Ceylon amount to some 32 million tons. The two biggest deposits are at Kurunegela (7.5 million) and Panirendauwa (5 million). Coking coal is non-existent in Ceylon and would have to be imported, but the internal power grid would be sufficient for the installation of an electric arc furnace.

Internal consumption is about 80 to 100,000 tons per year and will probably double by 1980. It is planned to add steelmaking capacity to the Ceylon Steel Corporation mill, with the introduction of an electric arc furnace, of which the initial capacity will be 65,000 tons, rising eventually to 108,000 tons. The aim is to supply the rolling mills, which is realistic especially since it will avoid billet shortages in boom periods and will therefore probably repay the investment. There is the drawback that it is not based entirely on home produced raw materials i.e. scrap and coal have to be imported; it might, therefore have been more advantageous to use the home iron ore reserves by beneficiating the ore, using direct-reduction processes.

India

Steel production in India started on a large scale with the almost simultaneous construction in the mid 1950's of the three integrated state owned steel plants at Bhilai, Durgapur and Rourkela, all operated by Hindustan Steel Ltd. (H.S.L.). Present capacity of the three plants is over 5 million tons but production last year was in the region of 3.5 million tons of crude steel. Labour disturbances and technological problems are the main causes of the underutilisation of capacity.

India's reserves of high grade iron ore are the biggest in Asia. The main producing areas at the moment are, by order of importance, Goa, Orissa, Bihar, Mysore and Madhya Pradesh. Last year's production was about 60 million tons of high grade direct shipping ore. The main coal producing districts are in Jharia and Bokaro districts. Production of coking coal was about 20 million tons in 1970 but of high ash content, which has a detrimental effect on blast furnace operations. Electricity is available locally from the state grid and is usually purchased from there by the steelworks. Other raw materials such as limestone, dolomite and manganese ore are available locally.

Productive capacity in India is well below steel consumption, and steel production is even more so, in particular due to the labour unrest at the Durgapur steelworks. It is forecast that steel demand in India will rise to about 12.0 million by the end of the 4th five-year development plan i.e. 1973-74, from the present consumption of about 9m. tons per year. There are extensive plans to meet this rise in demand by expanding crude steel capacity, primarily at the state owned steelworks which already account for 70 per cent of total home production. The expansion plans for Rourkela, Durgapur and Bhilai will raise capacity by 700,000 to 800,000 tons at each works, to a level of 2.5, 3.4 and 2.5 (rising later to 3.6) million tons per year respectively. Besides these expansions, Hindustan Steel Ltd. (H.S.L.) are building a new steelworks at Bokaro with a planned capacity of 1.7 million t.p.y. of crude steel by 1973 rising to 4.0 million t.p.y. by 1976. H.S.L. also intend to build two more integrated steelworks by 1978/9, at Vishakhapatnam in Andhra Pradesh and at Hospet; both will have a crude steel capacity of 2.0 million tons per year. A special steels plant at Salem, Madras is planned, as a complement to the Durgapur special steels production. Completion of all these projects would raise the total capacity of H.S.L. to 17.5 million tons per year of crude steel by 1980; it is quite possible, however, that the two plants planned for 1978/9 as part of the 5th five-year plan will not be commissioned by 1980, and in any case output will probably continue to be well below capacity. Nevertheless, H.S.L. production of crude steel in 1980 is likely to be approaching 10 million tons per year.

There are also two privately owned concerns with substantial steel production - Tata Iron & Steel (TISCO) and Indian Iron & Steel (IISCO) - who have expansion plans. The former intend to modernise their existing plant with only a marginal expansion of capacity, but IISCO plan to raise crude steel capacity by 1 million tons per year by 1974. The Central Engineering and Design Bureau of HSL co-ordinates all expansion programmes and participates in the design of new steel works. Encouragement is being given to private expansion, especially to build mini-mills (six of these have recently been given the go-ahead) based on scrap or on Direct Reduction produced sponge-iron; the state owned companies however, are still likely to produce 70 per cent or more of the total steel output at the end of this decade.

The rise in demand for steel is sufficient to justify all the projects indicated above, although there is almost certain to be some delay in the implementation of the Hindustan Steel plans, through difficulties with technology, equipment supplies, and plant supplies - such as the graphite electrode shortage. The total capacity for crude steel production in India ought to reach the 20 million tons per year mark during the 1980's.

Pakistan

Pakistan has iron ore reserves proved at 125 million tons. In the Kalabagh district, 35% Fe content ore has been discovered. High content ore (65%) is also found in the Chittral district. There were attempts in 1968 and 1969 to build an integrated works in the Kalabagh district with German (Salzgitter), Russian and French aid, but the project does not seem to have materialised. An integrated steelworks is being built at Karachi instead, based on imported ore. Coal reserves are potentially 190 million tons, but they do not seem adequate for steelmaking. Integrated steelworks therefore have to be based on imported coal supplies. Natural gas reserves are estimated at about 600,000 million m^3 and electricity generating capacity is about 1.5 million kw.

The country's steel is produced by semi-integrated works, and some 130 small re-rollers with combined capacity of about 275,000 tons. The development projects are co-ordinated by Pakistan Development Corporation, and in East Pakistan by the EPIDC (East Pakistan Industrial Development Corporation). The latter owns the Chittagong Steel Mills, which will be sold to private companies in the near future. The Pakistan Chamber of Commerce also advises as to the future of the Industry, and has recently been encouraging the establishment of mini-mills for West Pakistan, which would ensure self-sufficiency in this area. In total, U.S. $ 21 million have been allocated to the steel industry for modernisation of plant, and U.S. $ 260 million for new plant, of which U.S. $ 180 million will be financed externally.

Pakistan's consumption is running at a level of about 1 million tons per year, of which some 750,000 t.p.y. are imported. The integrated works programmed for Karachi and Chittagong are therefore reasonable if markets alone are considered; costs of imported raw materials must also be considered, in order to decide whether it would be economical to construct an integrated steelworks. The U.S.S.R. favourable appraisal and aid will eventually lead to the construction of the two integrated works mentioned above, which will provide 70% of the forecast 2.0 million t.p.y. Pakistani steel market.

The Pakistan Steel Mills Corporation at Karachi will eventually have a capacity of 1 million tons of crude steel; the Chittagong Steel Mills capacity is planned to reach 250,000 tons per year.

There are other projects of less importance, mainly in special steels. The Valika Steel Works Ltd. with Japan's IHI aid, plans a steelworks at Manghopir of 20,000 t.p.y. capacity, requiring U.S. $ 14 million investment.

2.10 Europe

General

The countries which have been considered in dealing with this region are Cyprus, Greece, Ireland, Turkey and Yugoslavia. Of these, Cyprus does not have any steelworks or any plans for one, and Ireland's existing steelworks has an output of only 75,000 tons of crude steel. Greece currently has one integrated steelworks with a capacity in excess of 100,000 tons. By comparison, the steel industry is well developed in Turkey and Yugoslavia; the former has two integrated plants with a total capacity in 1967 of over 1,000,000 tons of crude steel and, in addition, three smaller plants with a combined capacity around 100,000 tons per year. Yugoslavia has eight plants, of which the largest has a capacity of over 1,000,000 tons and the combined capacity approaches 3,000,000 tons per year of crude steel.

Greece

The only integrated steelworks in Greece is Halyvourgiki at Eleusis, which has a capacity of 340,000 tons per year of crude steel. The Hellenic Steel Corporation has an output of some 250,000 tons of steel products but no iron or steelmaking capacity; it is thought that their capacity is planned to increase to 900,000 tons per year by 1980.

There are several expansion possibilities under discussion for the Greek steel industry, of which the most important appears to be the proposal for an entirely new integrated steelworks, probably at Thessaloniki. This is intended to produce 1,000,000 tons per year of crude steel initially, rising eventually to 2,000,000 tons; it is possible that this plant may be partly state-owned and the Greek government appears confident that the project will be realised. The industrialist Tom Pappas, owner of the Hellenic Steel Company, is also deeply involved in the project. Hellenic Steel may themselves install either a blast furnace or an electric steelmaking furnace using scrap and/or pellets from a local direct reduction plant.

Steel consumption in Greece is currently 1.1 million tons of steel ingots per year, as compared with an output of 550,000 tons local production. Local capacity is in fact 1.2 million tons of steel but the Halyvourgiki plant is only operating one of its two blast furnaces, producing 400,000 tons. There have recently been two licences granted to Greek firms to establish steelworks worth a total of $ 7.8m. of which no details are known. Nevertheless, there is scope for the implementation of plans for expansion at Hellenic Steel and for a new integrated plant, in terms of the domestic demand for steel.

Ireland

Irish Steel Holdings intend to double the capacity of their existing steelworks by the introduction of a 30-ton electric arc furnace for casting $2\frac{1}{4}$ ton ingots. This will operate on scrap and imported pig iron and is expected to be operating early in 1973 when capacity will be about 135,000 tons of crude steel. Their mills will also be modified to increase output by 54,000 tons of billets, 11,000 tons of sections and 24,000 tons of bars and rod. The total cost will be in the region of £3.2m. sterling, of which approximately £1m. will be financed by the company. Since apparent steel consumption in Ireland in 1969 was some 400,000 tons in ingot equivalent, the entire output of Irish Steel Holdings could be absorbed by the home market, although it is expected that a proportion of the product will be exported, depending on market conditions.

Turkey

Of the two larger integrated steelworks in Turkey, only the plant at Eregli appears to have firm plans for expansion. Details of their programme are not available but it seems that their capacity will have risen in 1971 to 700,000 tons and will be increased in 1972 to approximately 1,000,000 tons. As regards the second plant at Karabuk, there is no indication of any plans to expand capacity in spite of a recent report by a United Nations consultant that they are attempting to improve productivity.

The same report concluded that improvement and enlargement of these two plants would be more beneficial than building a third integrated steelworks on a greenfield site. Nevertheless, the Turkish Government decided on the latter course and construction started in 1970 at Iskenderun, following a contract to design and supply the equipment, with Tiajpromexport of the U.S.S.R. who are providing a loan of $263m. The Turkish Government is providing the balance of $150m. required in local currency for the $340m. steelworks and $70m. of associated works, i.e. roads, rail, power supplies, training etc. The steelworks will consist of two 1386m^3 blast furnaces with an output of 1.1 million tons, two 130 ton oxygen converters, three four-strand continuous casting units (bloom sizes 265 x 340 mm. x 10m. long), and three rolling mills - billet (955,000 tons), light section (330,000 tons) and wire rod (300,000 tons). The crude steel capacity of 1.1 million tons is expected to be reached in 1974 when output will be:

000 t/a	Product type
20	Flats 4-12 m/m x 12-70 m/m wide
100	Sections 20 x 20 to 50 x 50 mm angles
210	Reinforcing bars 8-30 mm. round, square and hexagon
300	Coiled rod 5.5 - 10 mm. dia.
300	Billets 80 x 80 mm.

All products are intended for the home market.

It has very recently been indicated by the Turkish Ministry of Industry that a fourth steelworks is already definitely planned for construction near Sivas in Eastern Turkey. The design and the first site works are due for completion by 1974, although financial arrangements have not been settled. No further details are known.

Yugoslavia

The eight steelworks in Yugoslavia satisfy about 70% of the domestic demand for steel products, of which about half a million tons were imported in 1968, mainly in the form of flat products. The crude steel output of these eight plants was just short of 2.0 million tons of crude steel in 1968 (and 1.5 million tons of rolled products). This can be compared with the target capacities set for 1970 and 1972, in the 1963 national plan; the figures given for each works as 1968 capacity are estimates only, (all figures are in thousands of tons):

	1968 Capacity	1970 Target	1972 Target
Zenica	1,060	1,040	N.A.
Skopje	600	600	"
Jesenice	560	475	"
Smederovo	110	380	"
Sisak	280	285	"
Niksic	170	185	"
Ravne	150	150	"
Store	90	110	"
TOTAL	3,020	3,225	4,300

However, the actual capacity and output in 1968 of individual plants was well below their theoretical capacity - for example, the actual capacity of Skopje in 1969 was only 300,000 tons. Attempts are being made to reach the 1972 targets by completing Skopje and installing a new 800,000 tons per year blast furnace at Zenica, although it is unlikely that Skopje will in fact reach 600,000 tons before 1974. Crude steel output from Zenica is expected to reach 2.5 million tons by 1975 and 4.5 million by 1978. The plant at Niksic is undergoing a modernisation programme to increase their current (1970) output of 135,000 tons per year to 380,000 in 1978, and Smederovo is intended to become Serbia's only integrated steelworks with the introduction of a blast furnace and continuous casting, which will create a crude steel capacity of two million tons per year in due course. The steelworks at Sisak has been allocated 500 million Dinars for modernisation, which should boost production to 400,000 tons of steel by 1973. If these expansion plans all run according to plan, it should enable Yugoslavia to reach their original 1972 targets by 1975, when output is expected to be between 4.5 and 5.0 million tons per year.

At the same time, there has been a long-standing discussion as to whether a ninth steelworks should be set up. One possible site would be Prijedor in Bosnia, where there are iron ore reserves estimated at 60 million tons of Limonite of over 50%Fe, and a 1.5 million ton steelworks was proposed. A two million ton steelworks at Split was under consideration for several years, but the proposals were finally replaced by plans for a "mini mill", with 20 ton electric arc furnace and 2-strand continuous billet caster, which has just begun operation. The crude steel capacity will be 60,000 tons per year initially - expected to be in 1972 - which is planned to double within a further two years. The decision over the Split plant would appear to substantiate the indication that Yugoslavia intends, in developing her steel industry, to concentrate on expanding her eight existing steelworks.

CHAPTER 3 - DEVELOPMENT OF STEEL PRODUCTION AND CONSUMPTION IN COMPARISON WITH THE LEVELS AT THE END OF THE 1960'S

3.1 Steel Production

The developing countries have been classified into the major regions of Africa, Asia, Latin America, and Europe. This is consistent with the organisation of statistics in the United Nations document "The Growth of World Industry - Commodity Production Data". It should be noted that within these regions Egypt is included with Africa and Turkey with Asia. Mainland China and North Korea are included with the developed countries, as are South Africa and Rhodesia.

The source of statistics on steel production in the 1960's was "The Growth of World Industry" for years up to 1967 and the "Statistics Bundesamt Dusseldorf" for updating the figures to 1970. Initially, a trend line was drawn based on ten year moving averages; it was decided not to use this, in view of the discrepancy between the production and apparent consumption figures. The former are available up to and including 1970 while the latter are only available up to 1968. The actual annual production figures were therefore recorded on a scattergraph. A trend line was drawn from these figures, using linear regression to calculate the line of best fit. This trend line was extrapolated to indicate the estimated level of production in 1980.

The production figures for the years 1958 to 1970 are recorded below in Table 1, and the comparative levels of production in 1959, 1969, and 1979 are shown in Table 2. The trend lines used to establish the production levels at the end of the 1970's are also shown in Figures 3.1 to 3.4. The linear projection shown on these graphs is felt to be an adequate method of forecasting

TABLE 1 - ACTUAL TONNAGES PRODUCED (IN METRIC TONS)

Year	Africa '000 tons	Europe '000 tons	Latin America '000 tons	Asia '000 tons	Developing Countries m. tons	Developed Countries m. tons	World m. tons
1958	55	1237	3122	2192	6.61	267.63	274.24
1959	141	1402	3644	2901	8.09	297.11	305.20
1960	167	1576	4278	3783	9.80	336.71	346.51
1961	186	1663	5281	4618	11.75	339.50	351.25
1962	194	1730	6030	5725	13.68	346.31	359.99
1963	204	1773	6751	6574	15.30	372.20	387.50
1964	197	1885	7683	6759	16.49	417.57	434.06
1965	202	1949	7942	7411	17.50	436.52	454.02
1966	216	2052	9007	7904	19.18	452.97	472.15
1967	258	2021	9484	8020	19.78	476.27	496.05
1968	397	2272	11052	8330	22.05	491.75	513.80
1969	410	2735	11986	8449	23.58	552.62	576.20
1970	435	2725	12825	8306	24.29	567.91	592.20
Projected totals to:							
1979	600	3600	19700	14300	38.2	773.6	811.8

TABLE 2 - COMPARATIVE LEVELS OF PRODUCTION IN THE 1950'S, 1960'S AND 1970'S

1959	141	1402	3644	2901	8.19	297.1	305.2
1969	410	2735	11986	8449	23.68	552.62	576.2
Factor increase	2.9	2.0	3.3	2.9	2.9	1.9	1.9
1979	600	3600	19700	14300	38.2	773.6	811.8
Factor increase (on 1969)	1.5	1.3	1.6	1.7	1.6	1.4	1.4

future production, since there was no evidence in the scattergraphs of exponential trends in the steel production of any of the regional zones.

The comparative share of world steel production for each of the regions, and the changes expected in their relative shares, are indicated in Table 3:-

TABLE 3 - THE EXPECTED SHARE OF STEEL PRODUCTION IN DEVELOPING COUNTRIES DURING THE 1970'S

Year	Africa '000 tons	% of total	Europe '000 tons	% of total	Latin America '000 tons	% of total	Asia '000 tons	% of total	Developing Countries m. tons	% of total	Developed Countries m. tons	% of total
1959	141	0.05	1402	0.46	3644	1.19	2901	0.95	8.1	2.65	297.1	97.35
1979	410	0.07	2735	0.47	11986	2.08	8449	1.47	23.6	4.09	552.6	95.91
1979	600	0.08	3600	0.44	19700	2.43	14300	1.76	38.2	4.71	773.6	95.29

Thus the rate of increase in steel production appears to be slowing down in all four regions. Whereas the production of developing countries increased nearly three times in the 1960's, the level of production in 1979 is expected to be only one and a half times that of 1969; in terms of actual tonnage, the comparative increase is also slightly smaller. The effect of this, which can be seen in Table 3, is that the share of the developing countries in world production will increase only marginally by 1980, from 4.09 per cent to 4.71 per cent.

3.2 Steel Consumption

The source of statistics on apparent steel consumption was the Economic Commission for Europe publication "The Steel Market". (It should be noted that this publication does not indicate whether the United Arab Republic is included within Africa or the Middle East.) In these figures,apparent world consumption does not match world production of steel over several years. Although there is approximately one million metric tons of consumption unaccounted for by our statistical sources, data has been used on the assumption that consumption does not necessarily match total production every year. For similar reasons, there is some discrepancy between the figures for the four regions and total for all developing countries.

The scattergraph of consumption over the 1958-68 ten year period

TABLE 4 - APPARENT CONSUMPTION (IN METRIC TONS)

Year	Africa '000 tons	Europe '000 tons	Latin America '000 tons	Asia '000 tons	Developing Countries '000 tons	Developed Countries '000 tons	World '000 tons
1958	4152	1678	7949	10,077	23,856	246,283	270,139
1959	3731	1865	8051	8,477	22,124	282,674	304,798
1960	4299	2256	8437	10,823	25,815	319,555	345,370
1961	4517	2464	9599	11,896	28,476	321,905	350,381
1962	4572	2545	9081	14,253	30,451	329,497	359,948
1963	4773	2888	9882	15,729	30,120	357,479	387,599
1964	5947	3316	11640	16,824	37,727	396,336	434,063
1965	7059	3430	12253	18,160	40,902	413,117	454,019
1966	5808	3842	12923	17,431	40,004	432,149	472,153
1967	6402	3827	13202	18,779	42,210	453,843	496,053
1968	7144	3754	14802	19,848	45,548	482,514	528,062
Projected totals to:							
1979	10600	6600	21800	32,900	71,600	723,700	795,300

TABLE 5 - COMPARATIVE LEVELS OF CONSUMPTION IN THE 1950's, 1960's AND 1970's

1958	4152	1678	7949	10,077	23,856	246,283	270,139
1968	7144	3754	14802	19,848	45,548	482,514	528,062
Factor increase	1.7	2.2	1.9	2.0	1.9	2.0	2.0
1979	10600	6600	21800	32,900	71,600	723,700	795,300
Factor increase (on 1968)	1.5	1.8	1.5	1.7	1.6	1.5	1.5

demonstrates major fluctuations from year to year. Although linear regression does not provide an exact fit for this data, it has still been used as the most suitable technique for drawing a trend line. There is again no evidence of exponential trends, and the extrapolation to 1980 has therefore been drawn on the basis of these trend lines established by linear regression.

The figures for apparent consumption for the years 1958 to 1968 inclusive are shown in Table 4, and the comparative levels of consumption in Table 5.

It is clear from Table 5 that the rate of increase in steel consumption is slowing down, although not significantly. The apparent consumption of developing countries in 1968 was nearly twice the level in 1958, whereas by 1979 it is expected to increase further by a factor of 1.6.

In spite of this slowing down, the share of world steel consumption attributable to developing countries is likely to continue to increase at approximately the same rate over the next ten years. As shown in Table 6 below, the percentage share should increase by 0.51 per cent to 9.44 per cent by 1979, against an increase of 0.61 per cent between 1958 and 1968:-

TABLE 6 - THE EXPECTED SHARE OF STEEL CONSUMPTION IN DEVELOPING COUNTRIES DURING THE 1970'S

Year	Africa '000 tons	% of total	Europe '000 tons	% of total	Latin America '000 tons	% of total	Asia '000 tons	% of total	Developing Countries m. tons	% of total	Developed Countries m. tons	% of total
1958	4152	1.54	1678	0.62	7949	2.94	10077	3.73	23.8	8.83	246.3	91.17
1968	7144	1.48	3754	0.78	14802	3.07	19848	4.11	45.6	9.44	482.5	90.56
1979	10600	1.47	6600	0.92	21800	3.01	32900	4.55	71.6	9.95	723.7	90.0[illegible]

It is noticeable that the major part of the increase over the next decade will be attributable to Asia, with an increase of 0.44 per cent, and the developing countries of Europe, with an increase of 0.14 per cent, whereas the shares of Africa and Latin America are expected actually to decrease by 0.01 per cent, and 0.06 per cent respectively.

3.3 Conclusions

Steel production in the developing countries appears to be increasing at a slower rate, whereas their steel consumption is expected to rise over the next decade at much the same rate as in the 1960's. Nevertheless, their share of steel production is rising marginally faster than their share of still consumption. The effect of this is seen the percentage contribution of the developing countries internal production to their internal consumption. The figures are shown in Table 7:-

TABLE 7 - THE PERCENTAGE CONTRIBUTION TO INTERNAL CONSUMPTION FROM INTERNAL PRODUCTION IN THE DEVELOPING COUNTRIES

	Africa '000 tons	% of consumption	Europe '000 tons	% of consumption	Latin America '000 tons	% of consumption	Asia '000 tons	% of consumption	Developing Countries m. tons	% of consumption
1958										
Production	55	1.32	1237	73.72	3122	39.28	2192	21.75	6.61	27.70
Consumption	4152		1678		7949		10077		23.86	
1968										
Production	397	5.56	2272	60.52	11052	74.67	8330	41.97	22.05	48.41
Consumption	7144		3754		14802		19848		45.55	
1979										
Production	600	5.93	3600	54.25	19700	90.50	14300	43.43	38.25	53.42
Consumption	10600		6600		21800		32900		71.60	

The gap between the apparent consumption and the steel production of the developing countries will reduce by 1980, on the basis of the trend lines estimated. However, the increase in their percentage contribution between 1968 and 1979 will be very much less than the increase during the past decade. Unless something is done to boost the rate of increase of steel production during the next decade, it is probable that at some time in the comparatively near future, the developing countries will cease to improve the contribution of their steel production to internal consumption.

The variation between the regions is also noticeable. Only in Latin America is there a significant movement towards self sufficiency in steel production by 1980, when they should produce 90% of their home demand. In Asia and Africa the improvement is marginal, and the European developing countries appear likely to contribute significantly less to their internal steel consumption.

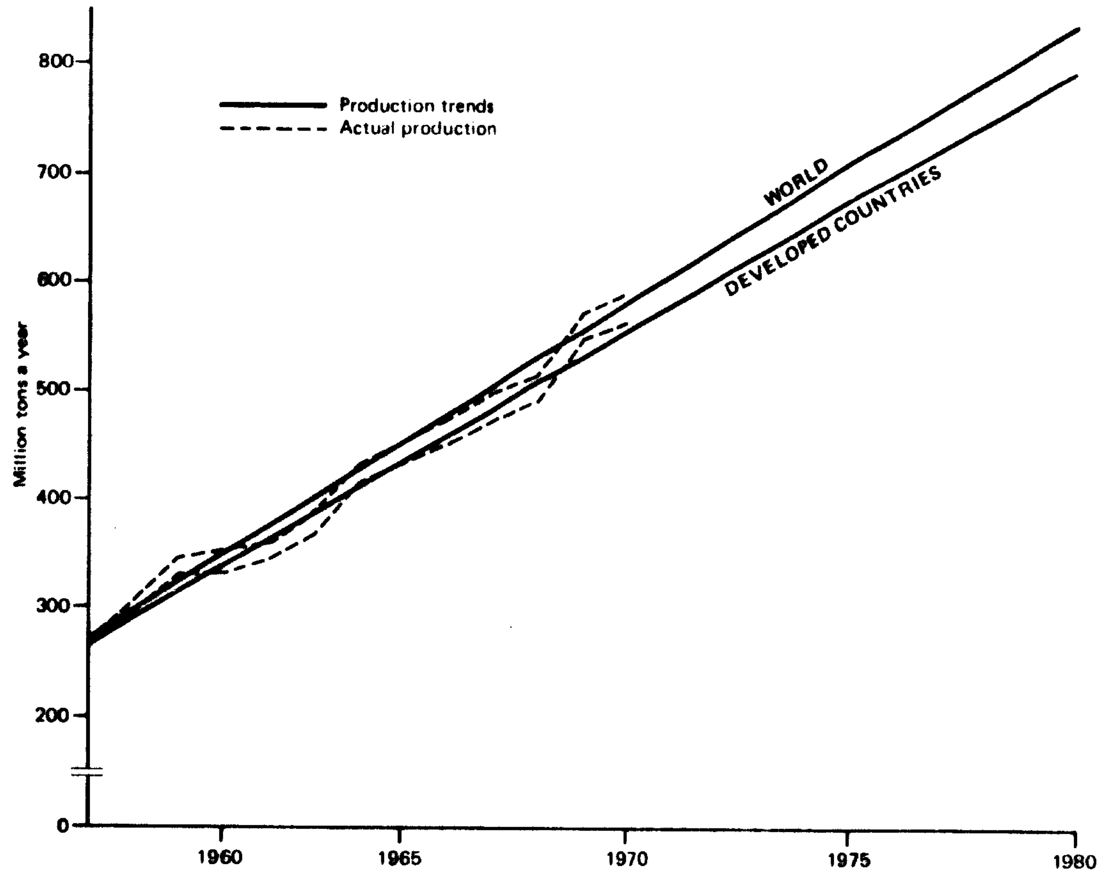

FIGURE 3.1 – PRODUCTION–THE WORLD AND DEVELOPED COUNTRIES

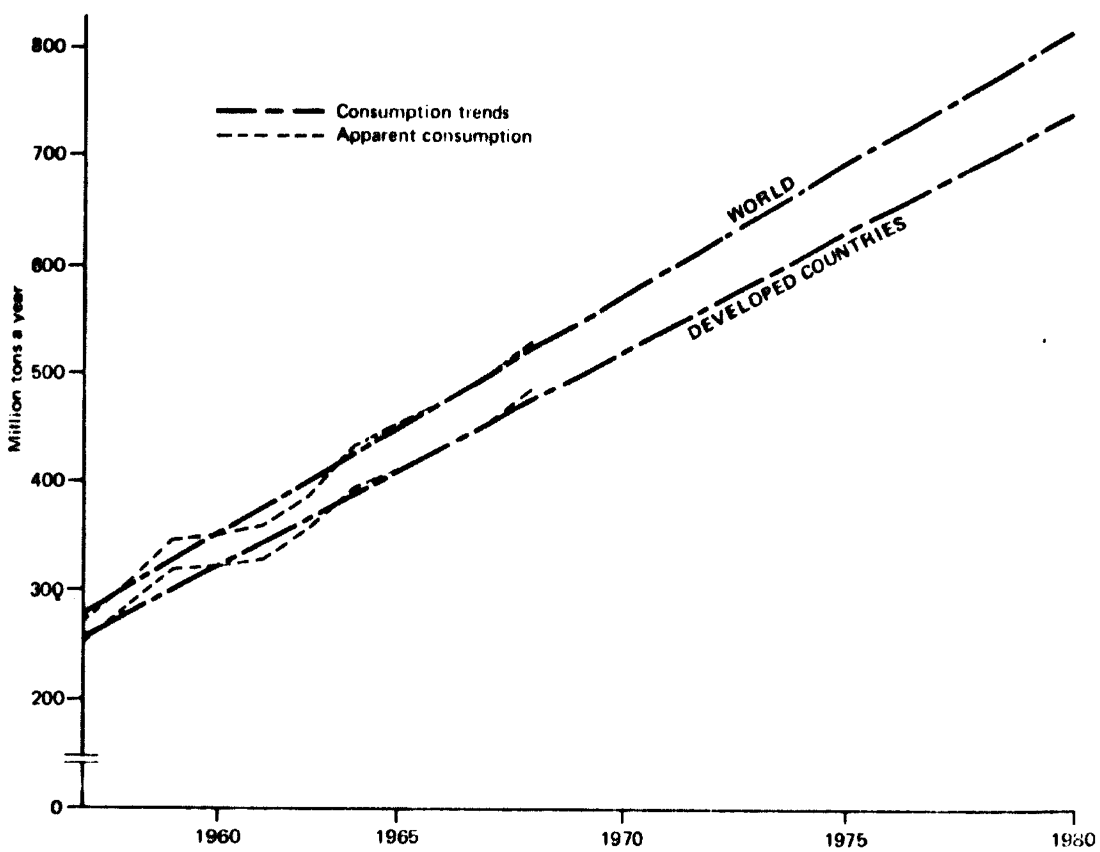

FIGURE 3.2 – APPARENT CONSUMPTION–THE WORLD AND DEVELOPED COUNTRIES

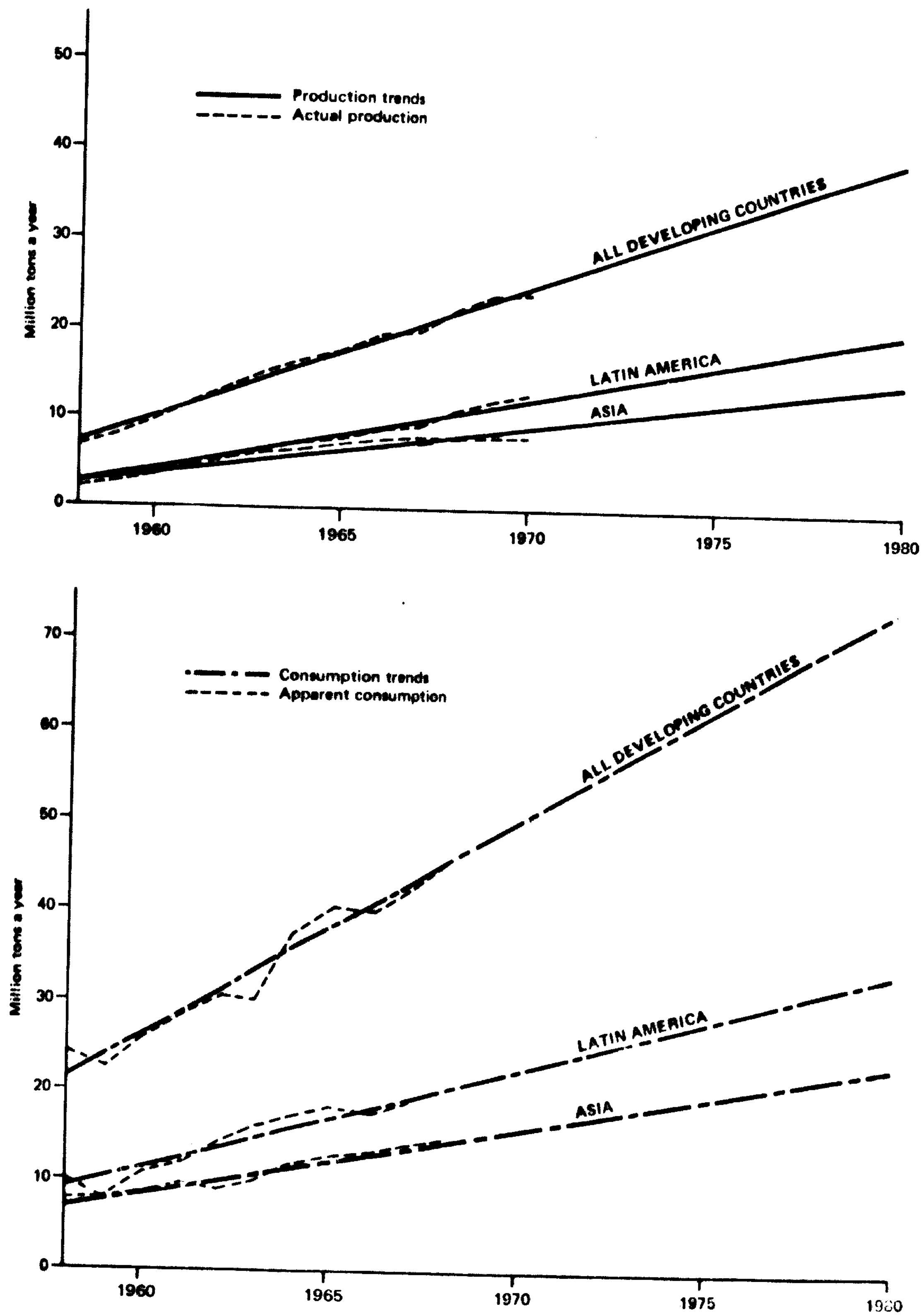

FIGURE 3.3 – PRODUCTION AND APPARENT CONSUMPTION: ASIA, LATIN AMERICA, AND ALL DEVELOPING COUNTRIES

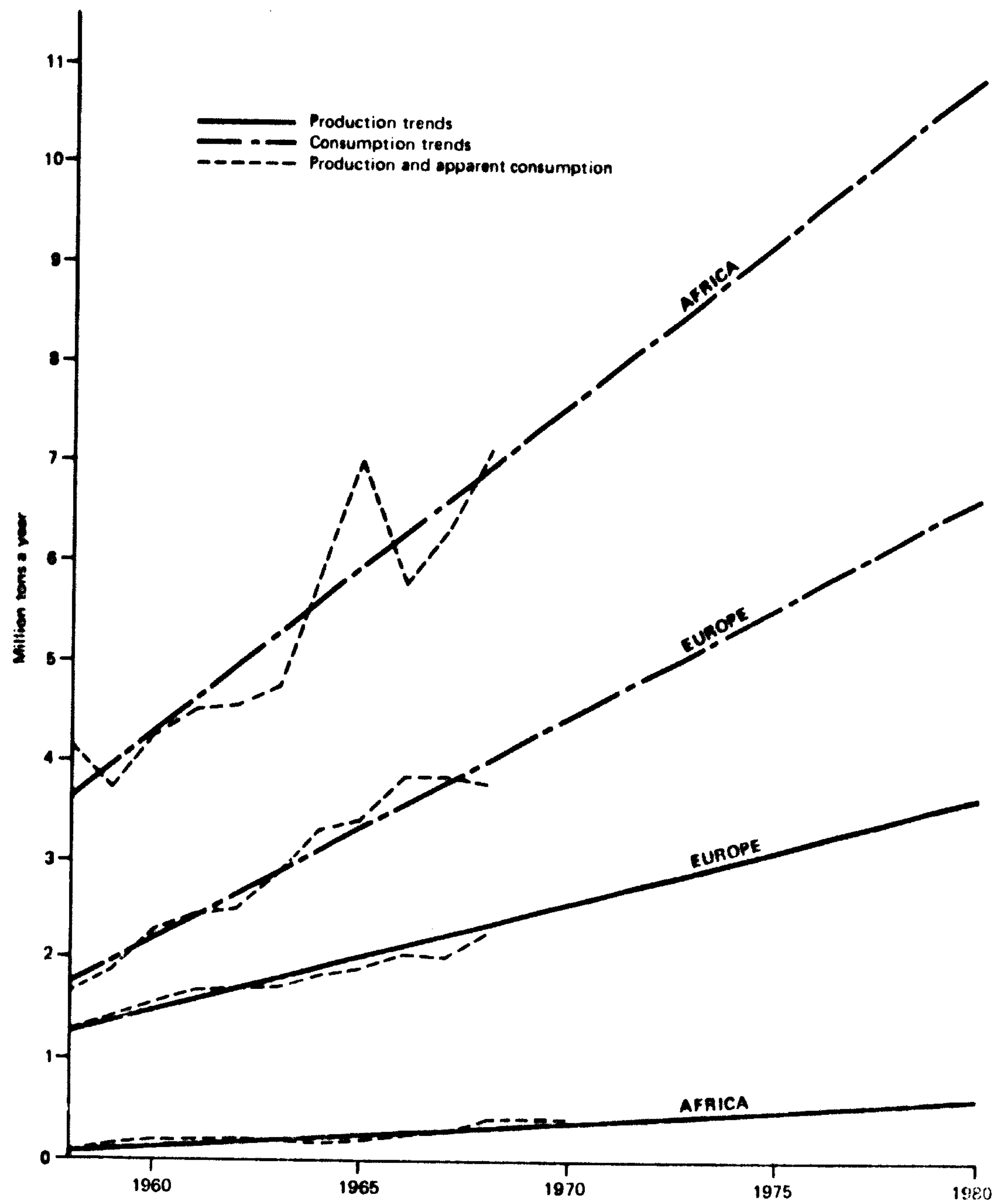

FIGURE 3.4 – PRODUCTION AND APPARENT CONSUMPTION–AFRICA AND EUROPE

CHAPTER 4 - DEVELOPMENT OF IRON AND STEEL TECHNOLOGY

4.1 The Available Process Routes to Steelmaking

Liquid iron or sponge iron

There are a number of different process routes in use today for making steel. They fall into two broad categories, the "hot metal" route involving the production of liquid iron at an intermediate stage, and the "cold metal" route in which steelmaking is based on the use of scrap or reduced pellets of sponge iron. In those routes falling into the first category the production of liquid iron traditionally takes place in a blast furnace, but other processes are in use as, for example, the electric arc shaft furnace. The liquid iron is refined to steel in open hearth or basic oxygen furnaces (e.g. LD, LDAC or Kaldo). The open hearth process is obsolescent, and one of the basic oxygen furnace routes is likely to be considered for a new works. Of these, unless special conditions such as high phosphorus levels dictate use of the LDAC route, the process normally chosen would be the LD. In routes belonging to the second category there are now a number of "direct reduction" processes in which the intermediate product takes the form of solid sponge iron. This highly reduced material can be charged into an electric arc steelmaking furnace in place of, or in addition to, scrap.

There are thus a number of technically possible process routes up to the liquid steel stage, but in any particular situation many of them are ruled out on economic grounds. If a completely new works on a greenfield site is under consideration the choice of process route is likely to be one of two hot metal routes: either a blast furnace or an electric smelter feeding liquid iron to a basic oxygen process. However, where the scale of operation is not large enough to justify a blast furnace, the cold metal routes would be considered, using an electric arc furnace fed either with scrap or with sponge iron. In developing countries with their own iron ore and little scrap available, the direct reduction process is of particular significance, and is therefore dealt with in detail below.

Direct reduction processes

Of the many different processes for producing sponge iron, few have been developed beyond the experimental pilot plant stage. They differ from one another in the reductant that they employ (coal, oil or natural gas) and in the degree of reduction achieved. The subsequent processing of the sponge iron depends on this degree of reduction: however, the feature of any direct reduction route that is most sensitive to economic and geographical considerations is the type of fuel that it uses. Processes using natural gas to produce sponge iron include:

HyL	In commercial use for many years in Mexico
H - Iron	Found uneconomic compared with scrap prices
Midrex	One commercial plant in use.
Esso-FIOR	Pilot plant in use
Futakuski	Pilot plant in use

There are also many coal or coke using processes, including:

SL/RN	Two plants in the early years of commercial use.
Krupp-Renn	Used in Germany for low-grade ores but most plants now closed
Hoganas	High grade but expensive product
Echevarria	High grade product, but only used on very small scale

Of those processes using a solid fuel the SL/RN is the one with most experience available.

There are also direct reduction processes using electricity as a source of heat and only enough gases or solid fuel to supply the necessary reducing agent, for example, the Wiberg process used for special steel production in Sweden.

However, these are not as widely applicable as the processes using electricity for iron-making (Elkem, Tysland Hole) which are already in operation and which produce liquid iron.

Steelmaking process developments

There are other new steelmaking processes such as spray steelmaking, the dual-hearth furnace, continuous steelmaking processes, etc. As with most of the direct reduction processes, however, these are probably inappropriate to a works now being designed, on the grounds of too little experience on a reasonably large scale, despite their potential theoretical advantages.

Whatever judgement is made at the present time about the economic and technical suitability of new processes, the list of likely processes will have to be reviewed periodically. Any new process goes through a cycle of development, starting with a theoretical evaluation supported by empirical laboratory data, progressing to the pilot plant stage to develop the most suitable operating characteristics, and culminating in the design and construction of a commercial scale plant. The cycle of development from the initial idea and laboratory work to the first successfully operating commercial plant has in the past taken ten years. Only at the last stage have the operating costs been established, and many of the practical problems of operating and maintaining the plant have not manifested themselves at any earlier stage. The process routes which have been selected for discussion are representative of all routes which are likely to be installed in the short and medium term future.

Combining the iron-making and steelmaking phases, there emerge five different representative routes to the production of liquid steel in a completely new works:

(a) Blast furnace + basic oxygen furnace
(b) Electric arc shaft furnace + basic oxygen furnace
(c) Gas-fired direct reduction plant + electric arc furnace
(d) Coal-fired direct reduction plant + electric arc furnace
(e) Scrap-charged electric arc furnace

4.2 Factors Affecting Process Selection

The factors

The choice of process will be affected by the location of the works primarily because the resources available vary from one area to another. These resources include not only the available materials, but also labour, money and the opportunities for selling the products. The main factors considered to be of greatest importance in determining the choice of process routes are: the raw materials available; the fuels or sources of energy available; the markets for steel products and their rate of growth; the ease of obtaining finance for purchasing and running the plant; and the technological risk. These factors are discussed in the following articles.

Raw materials

A high-quality iron ore, that is, one having a high iron content but low in sulphur and phosphorus and free from undesirable alloying metals, can be used for any of the first four routes. If the ore does not match up to these standards, there may be process routes for which it is unsuitable. For example, an ore with a low iron content is unsuitable for direct reduction processes unless it can first be beneficiated, whereas it can be used in a blast furnace because this process has a means of getting rid of the gangue in the form of slag. On the other hand, an ore like the New Zealand titanium bearing ironsands cannot be used in the blast furnace, in particular because the slag would be too viscous, but it has proved possible to use it in a direct reduction process. A high phosphorus content, while not affecting the iron-making part of the process route, imposes limitations on the subsequent steelmaking process.

The theoretical maximum value to the steelmaker of the price of scrap is determined from a comparison of the costs of steelmaking using iron ore or scrap. However, the cost of obtaining scrap is in many circumstances very low and some people will even pay to have it taken away. There is thus sufficient scope for flexibility in the price of scrap to ensure that those quantities which are readily available will be used. This availability will have an influence on the process routes adopted.

Fuels

There are three reasons why fuels have an important impact. Firstly, fuels form one of the largest single cost items. Secondly, in certain instances, fuels are a highly localised commodity which may be more available in one location than another. Thirdly, and in contra-distinction to the previous point, some fuels, like raw materials, are available on an international market and are on the one hand available to all, but on the other hand subject to world fluctuations in availability and price. The various fuels will be discussed in terms of these three points.

(a) Coal

The use of metallurgical quality coal in the blast furnace route is the largest single fuel cost incurred by any of the routes. It may be nearly twice the cost of using coal in a direct reduction process. Thus in comparing these two process routes, two issues should be taken into account. First, in any specific location it may be that cheap coal which is unsuitable for the manufacture of coke but which is suitable for the direct reduction process is available.

A second, and perhaps more important issue concerns the world availability of coke and coal today and in future. Metallurgical quality coal can now be regarded as an international commodity and one in which the price will reflect the level of world demand. At present there are increasing signs of a scarcity of this coal and there are no clear indications of how this shortage will be satisfied in the future. Clearly, the substantial reduction in coke rate which has occurred through the use of oil and oxygen injection, has helped to alleviate the problem. Any further rises in the price of metallurgical coal, and hence coke, will lead to further substitution. However, there is a limit to the amount of oil injection which can be used, and additionally, a minimum quantity of about 350 kilograms per ton of coke has been postulated for the blast furnace. If the shortage of metallurgical quality coal is to continue, these improvements in practice will only put off the day of reckoning rather than remove the basic problem.

(b) Electricity

Electricity has a smaller impact on the cost of steel than coal, but still a significant one where the electric arc process is used for steelmaking. In a number of countries, electricity can be generated at very low cost, particularly where hydro-electric schemes can be installed.

There are two technical points which should be made concerning the use of electricity based processes. The first is that it can be difficult in a country with a small consumption of electricity to provide the required "stiffness" at the point of supply. Thus the feasibility of installing electric arc furnaces may well depend upon the general level of industrial development in the country. The second feature concerns the way in which the steel industry develops in a country. Clearly, there is an economic link for electric arc furnaces between the costs of melting scrap or reduced pellets, and hence as a country develops to provide more of its own steel requirements, it may be that the most natural step is to develop from the melting of scrap to the melting of reduced pellets. In such circumstances direct reduction ironmaking would be the natural technical course of development.

(c) Natural Gas

The gas-fired direct reduction process has a higher basic cost than the coal fired D.R. process or the blast furnace route and it would require a very low price for natural gas relative to other fuels in the particular location for the process to be economic. Although many countries have substantial supplies of natural gas, the level of refinement of the fuel, its suitability for other applications, and the high costs of the gas-fired direct reduction process make it unlikely that it will be widely used in the steel industry.

Markets and growth rate

In a country in which a new steel industry is to be established, the major determinant of the size of plant to be installed is the size of the market demand at that time. Steel is a prime material for the development of engineering industries in a country and in many cases is considered to be a necessary catalyst for such development. Hence it is not surprising that most of the countries of the world have sought to establish a steel industry as soon as they could economically justify it. Thus, the picture emerges that new countries wishing to establish their own steel industry require small plants. This is happening at a time when more industrialised countries are moving to larger and larger plants.

A second important factor is that having at some point in time established a stable base line, the next problem is the phasing of plant to match the growth of the market. This is not a simple problem, and it can be related to other factors, for example, plant renewal.

Financial factors

In many countries import replacement is of great importance in establishing a steel industry. Governments are interested in the changes in the foreign exchange costs which will be incurred by manufacturing their own steel relative to the situation in which they import it. In analysing different process routes, therefore, they will be seeking those factors which allow a greater degree of indigenous contribution and the maximum amount of import replacement. The capital elements in the various process routes are fairly similar and it may be presumed that the level of manufacturing expertise required is similar for the various process routes. Thus, an industrialised country would expect to be able to manufacture its own requirements. A less industrialised country might be able to make minor items but not major ones and a developing country to provide a small part only of the plant required. However, these contributions would not be significantly different from the various process routes.

In a similar way, demands for manpower and various sundry operating requirements would be similar for the various processes, the aim being to supply the maximum from within the country and only a small amount being imported.

The main area of potential difference lies in the field of raw materials - iron ore, coal, fuel and energy. The technical reasons governing the choice of these have been discussed earlier. In certain cases, the use of a small surcharge on imported materials of only 10-20 percent could alter the decision in favour of a process which uses more indigenous materials.

A different factor which can affect the decisions is the cost of capital. Where there is only a small difference in the capital cost, it might be expected that the effect of changes in the cost of capital would be negligible. Differences in costs between the processes are not large. However, as a number of the cost per ton curves have similar shapes there is a range of outputs either side of the cross-over point at which the costs are not significantly different. Changing the cost of capital does for this reason, therefore, have a considerable impact on the level of tonnage at which two processes break even. Clearly, if the costs of two processes are very similar then cost as a criteria will become less important and other criteria will dominate. These will be of a technical character and will, in particular, include risk.

Technological risk

One of the most complex parts of the comparison between processes is to feed into the various costs and performance parameters, factors which reflect the technical state of development of one of the processes which is at an early stage in its history. Theoretical predictions can be made of the consumption of materials, operating costs and management skills which will be needed when the process has been fully developed. However, the task of indicating any differences arising from the manpower available, particularly in respect of the level of skills and experience which may be required to commission a blast furnace and LD steelmaking plant as opposed to a direct reduction and electric arc steelmaking works is much more difficult and the issue is open to debate.

A further complication is the anomaly that the new technical processes are not being installed and experience gained in acknowledged steelmaking countries. This is of course because the new processes have greater economic advantage at the smaller levels of output. This raises an interesting point with regard to the technological progress of developing countries. In many fields the aim has been for these countries to take advantage of the latest developments pioneered by the industrialised countries and to take technological short cuts by using the latest plants. Here, however, the developing countries move in certain circumstances along a completely new path, untrod by the industrialised countries.

It is the years required to reach the normal operating levels which are crucial. First, because low outputs during this time mean lost revenue and higher costs (which in an open market situation cannot be recouped), leading to a lower overall profitability. Secondly, and perhaps even more importantly, is the effect on the liquidity of the business of a change in the cash flows.

4.3 The Development of Steel Industries

In addition to the relevance of the various factors discussed above, the way in which the steel industry in a country has or will be developed may have a far-reaching effect on the decisions to be taken.

In the first case, there is the position of an emerging industry in a country which hitherto has not manufactured any of its own steel. There can be a number of aspects of the industry which can form the focus around which it will develop. In some cases countries have launched their steel industry with the pre-requisite that it shall use indigenous materials. Tunisia and New Zealand are typical examples of two countries which have begun in this way. In New Zealand in particular, this had a major impact for technical reasons on the choice of the process. A number of other countries, however, have launched their industries on the scrap generated within the country from imported steel. Singapore is an example of this type, with a steel industry of about 0.1 million tons capacity. This satisfies only a part of the requirements of the country so that excess steel is still imported and the scrap arising is sufficient to feed the works.

The decisions to be made in an established industry can be radically different from those which are to be made in a new industry. In an established industry, the decision is rarely the simple one of how to expand the capacity of the industry. On many occasions, this will be an expansion/replacement decision in which obsolete facilities are closed at the same time as the extension is made, thus allowing the installation of a larger plant than would have been required solely for growth. In other cases it may be that within the existing works at certain stages there is an out-of-balance, i.e. an excess capacity at one process level relative to the capacities at other levels. Expansion can then be achieved overall by increasing the capacity at the stages in the process which are bottlenecks. In many cases the decision as to process is pre-empted because of the large amount of heritage of plant in the upstream and downstream areas. A further ramification is that it may be possible to increase the capacities of existing facilities either by engineering or by changes in practice.

One final point which should not be overlooked is the overall position as regards competition within the industry, both within countries themselves and internationally, together with the attitude of the industry to technical progress. The steel industry typically is in a highly competitive situation. The question arises therefore as to how a steelmaker, when making a decision about the processes which he should use for a new installation, should balance the potential for lowest costs of a new process (and hence greatest profit) on the one hand against the risks attendant upon its initial development on the other. Technological development in the industry has been slow and turnover times for plant have been long, of the order of 20 to 30 years. Only now are operating lives of 15 years, which reflect the greater price of technological change, being included in feasibility studies. However, although a steelmaker may be at risk to a single competitor putting in a new plant it is unlikely that the whole industry will change character overnight.

In many instances in this situation there is a conservative attitude towards technological development which in many cases is based on sound commercial judgment. In particular, the question as to the amount of capacity which is to be devoted to a single process is a major issue. A steelmaker is even less likely to wish to be the first in the field if all his eggs have to be in the same new technological basket. Many have said that they would be happy to be second in the field because commercially they would not lose out too badly and would have saved themselves the technological [illegible] borne by somebody else. This raises the issue of who will then do the technological development, the steelmaker, the licensor, the plant suppliers, future interested steelmakers of any combination of these.

4.4 Current Schemes

An analysis of twenty three steelmaking schemes in twenty countries from whom Questionnaires were returned, shows that they all comply fairly logically with the criteria outlined above.

Eight schemes are based on the blast-furnace ironmaking, basic oxygen steelmaking route. One of these, in Thailand, is an extension to an existing works already using these processes. Another in Liberia, is a very tentative scheme for the productio. of 0.2 million tons a year. A third, in Honduras, is for the production of only 0.1 million tons a year, but is based on charcoal from locally grown trees. The other five schemes, in Korea, Peru, Turkey, Taiwan and Algeria are all new works (of which the latter is partly built) and all plan to have capacities in excess of 1 million tons a year. The scale of production envisaged in these five cases is such that the choice of the blast furnace as an iron-making process is almost axiomatic under present conditions.

There are two direct-reduction sponge iron, electric arc steelmaking schemes. One, for the production of 0.3 million tons, is in Libya. Here the plan is to use a gas-fired direct reduction process, using treated natural gas from the plentiful supplies available. The other, for the production of 0.2 million tons, is in Costa Rica. Here the process will be a coal-fired one. The reason for this choice lies in the type of iron ore available, which is a titaniferous magnetite sand. This will be concentrated and pelletised before being reduced in an SL-RN kiln. Such ores cannot be treated in the blast furnace because of problems with the slag. A similar plant, treating similar ore, has recently started operating in New Zealand. In both Libya and Costa Rica the choice of process is the logical one in the circumstances.

One tentative scheme in San Salvador is based on the electric smelting of their own iron ore, followed by electric arc steelmaking. Electricity is available by hydro-generation, and is therefore presumably cheap.

Twelve schemes are based on electric arc steelmaking from scrap, without any associated iron making processes. Three of these, in Ireland, Ecuador and

Tunisia, represent extensions of between 30,000 to 60,000 tons per annum to the outputs of existing steelworks. In Ireland the existing plant is already scrap-based, using an open hearth furnace. This process is obsolescent, so that it has proved more economical to expand the works capacity by adding an electric arc furnace instead of a second open hearth. In Ecuador, the existing plant is a rolling mill using imported billets, and the new plant is a logical development "up-stream" to manufacture their own products for rolling. In Tunisia, the existing plant uses the blast-furnace ironmaking, LD steelmaking route. The addition of an electric arc furnace gives scope for extra steel output without the cost of adding to the ironmaking plant or increasing the demands for blast furnace coke, supplies of which are a problem.

Nine electric arc steelmaking schemes are for new works, one each in Saudi Arabia, Senegal, Ceylon, the Sudan and Kenya, and four in Vietnam. As a means of initiating a steel industry in each of these countries on the scale envisaged (the schemes vary from 12,000 to 65,000 tons a year), this would be the accepted choice of process.

CHAPTER 5 - CONCLUSIONS

5.1 Factors Determining Steel Industry Development

Consideration of the many projects for developing integrated steelworks or expanding the capacity of existing plants, which have been outlined in Chapter 2, indicates that development plans are sometimes made without strict reference to the immediate profitability or viability of the particular plant. This in itself is not to say that such development is unjustifiable, since there are factors involved in determining the optimum size and character of a countries' steel industry, other than the profitability of an individual plant. The criteria involved in making decisions on the future direction of a country's steel industry include economic, sociological, political and technological considerations.

Economic Factors

Economic factors primarily affect the viability and profitability of an individual steel plant. They are governed by the nature of demand for steel products within a given country or market area, by the availability of resources, and by the product mix chosen, as well as by the technological factors already discussed. The optimum capacity of the steelworks will partially depend on the volume of unsatisfied demand of the relevant market area i.e. the total demand less the capacity of existing facilities in that area to satisfy it, but also on the variations in that demand projected over the life span of the project. It is important to assess the growth of markets both in terms of the changing levels of demand and of alterations in the balance of products required; a rapid growth, for instance, followed by a steady demand will justify a higher capacity plant than a steady growth over a number of years, albeit to the same level. An assessment of the future pattern can be made by studying the growth of user industries such as the construction industry.

The product mix will also affect the chain of processes and the economic viability of the plant. The product range will govern the capacity required - if heavier products must be produced, their capacity will have to be higher; if there is a large demand for only one line of products, this may cause underutilisation of one process in the chain, thereby loading the cost of supplying that product.

The availability or otherwise of resources will be a restraint on the capacity of a steelworks, which will operate economically in the sense that a shortage can be overcome physically by importing raw materials or rewarding labour highly, but will thereby push up the cost of operating the plant. Such resources include raw materials, fuel, power, water, manpower and finance including both internal capital and foreign exchange.

These factors, together with the technological aspects of setting up new steelworks, will all affect the future profitability and therefore the commercial viability, of such a project. They are the conditions and factors which govern the decisions of the business man. They may not necessarily be the only or indeed the dominant factors in any assessment of the future direction to be taken by a country's entire steel industry, which is often, indeed usually regarded as a national responsibility in view of its intimate relationship with the development of industry as a whole. Thus sociological and political criteria must be taken into account, and these may over-rule an otherwise uneconomic proposition alternatively, reduce the effectiveness of an otherwise sound plan.

Sociological benefits

It is primarily in the developing countries, where it is more often difficult to justify an iron and steel project on commercial grounds, that both sociological and political factors carry more weight. The benefits of a steel industry include such effects as increased purchasing power, higher levels of education and a better standard of living, which any form of industrialisation achieves by upgrading the value of the individual's work output and encouraging training and education facilities. Employment is very often a crucial factor, and not only does the development of a steel industry provide additional employment opportunities, but the type of process adopted can be manipulated to provide a maximum labour force; the reverse of this is that employment requirements are themselves a factor involved in the selection of appropriate guide lines for planning a future steel industry.

Import substitution is another result of developing a local steel industry. This can have a direct effect on general standards of living by freeing foreign exchange - if only in the long run - which can be used for imports of food or luxury goods.

Political strategy

The factors discussed above have all been of influence in company or national terms. In the developing countries particularly, there are often also international and therefore political considerations. The foreign exchange aspect already identified in considering sociological factors, is primarily a political factor - the saving of foreign exchange is often the major political economic aim of a government in encouraging the growth of new industries. Trade agreements and regional economic alliances are other aspects of political strategy. In many cases, a steelworks designed to serve a region may be justified, when the home demand for steel in the parent country may be well below the economic output of the plant. Regional co-operation on industrial projects, however, may be very difficult to achieve - for instance, the economic location of a steelworks to serve a number of countries may be unacceptable because of the foreign exchange problems caused for a number of the member countries. It is significant that there are to date no significant projects for integrated multi-national steelworks under way, although the plans of the five countries of the Central American Common Market for a joint venture (to be located in Honduras) appear to be realistic, with good prospects of being implemented.

Technology

The technological factors have already been considered in some detail in Chapter 4. They are now represented in more general terms to indicate their relationship to the other factors determining steel industry development.

The technological factors relate mainly to the capacity of the plant, which is in turn governed by the capacity of the individual process units. Decisions on the choice of processes will depend basically on three elements: the economics of scale, the relationship of capital to operating costs, and the process yields. It is a characteristic of process economics that the capital charge per unit of capacity decreases as the size of the plant increases However, in many of the countries under consideration, there may be an absolute restraint on the quantity of output which can be placed on the market, so that it is not possible to take advantage of the economies of scale. Thus it is all the more important to select processes which lend themselves to a low level of output.

Processes can be assessed in terms of their "comprehensive cost", only by taking account of both their capital and operating cost elements. [1] The relationship between capital and operating costs varies from country to country, and in general the position in developing countries is very different from that in developed countries, where the processes are likely to have been evolved. It is important to appreciate this when considering what processes to adopt. The yield of a process is determined by the technological characteristics of the process itself, but the overall yield of a chain of processes may vary considerably according to the precise arrangement of the different processes within the chain.

5.2 Future Regional Development

It is clear that any decision on the development of a country's steel industry must take account of a large number of factors, many of which may be in conflict. It is also very necessary to look at all these factors in the light of a time dimension, which will itself vary according to the type of project and the characteristics of a particular country. It is impossible so to arrange the

[1] See UNIDO paper, 'Determination of the Optimum Capacity of the Fully Integrated Iron and Steel Plant and its Parts". H.R. Mills and B.S. Soan.

capacity of a steelworks that it matches the demand made upon it, throughout its operational life - it will be necessary to balance the lost sales before implementation of a plant against under utilisation of capacity after commissioning it. The capacity of different parts of a steelworks complex must also be arranged as far as possible to match the varying growth through time of markets for different types of steel products.

While there are many projects described in Chapter 2 which have been worked out with due regard to the complex interaction of these many criteria, it is clear that there is a strong tendency in the developing world to promote the development of a steel industry without any real assessment of the true viability of the project. In particular, excessive weight is often placed on the political reasons for establishing an integrated steel industry regardless of the economic difficulties. Thus several of the schemes referred to in Chapter 2 will be delayed well beyond their proposed implementation date, if not for ever; others are likely to be modified to take account of the lack of reductant materials, product markets and so forth.

Some attempt has already been made to indicate the prospects of implementation, as part of the description of the particular schemes. A summary has been made below of the likely pattern of development in the various major regions, as opposed to the sub-regions treated independently in the body of the report.

Africa

As the figures in Chapter 3 indicate, both the production and consumption of steel is lower in Africa than in any other region of the world. The information which has been gathered in the course of this study from individual countries indicates that there are no large-scale projects for establishing integrated steelworks during the decade. The two most ambitious projects are in Algeria and Nigeria, where there are proposals to establish steelworks of a capacity of 500,000 and 750,000 tons per year respectively. The remaining projects are largely in terms of 100,000 to 250,000 tons per year. On this information production in Africa is unlikely to rise much during this decade, which accords well with the published statistics used to determine the trends indicated in

It is significant, however, that consumption in Africa is rising more steeply t' an production. There is therefore ample scope for boosting local production, in terms of the region as a whole. The problem is in part the nature of the African continent, which is fragmented into a large number of countries - by comparison, for instance, with South America. The home market of individual countries is not large enough to justify significant steelworks developments, which could only be commercially viable if they were to be set up on a regional basis.

It is clear that this has fundamentally been appreciated by the African countries, since two regional studies were carried out in the 1960's - for West Africa and for East and Central Africa. The recommendations of these studies have not been put into effect, which is probably a reflection on the overriding political needs of the countries involved to be seen to be developing their own steel industry. Unless such political factors can be overcome, to allow international co-operation for the establishment of regional steelworks, the overall production of steel in Africa will lag further and further behind demand, retarding the growth of these countries.

Latin America

The steel industry in this region is well established, and should be approaching self-sufficiency by the end of the decade. Production is already over two million tons per year in three countries - Brazil (5.4), Mexico (3.4) and Argentina (2.4) - who between them alone account for about ten times the total production expected for Africa in 1979. If the national plans of these three countries were all implemented, their total production by 1980 would amount to nearly 35 million tons; it is unlikely that their steel output will in fact reach this level, but it seems possible that Brazil alone may reach a capacity of 17 million tons per year by 1980, while Argentina and Mexico should both reach 5 million tons. In addition the prospects of Venezuelan capacity exceeding 2.5 million, Chile 1 million and Columbia and Peru about half a million tons are all good. Thus capacity could well be over 30 million tons by 1980, in which case a throughput in the region of 65 per cent of capacity would achieve the 20 million tons per year production forecast in Chapter 3.

It should thus be possible for the Latin American countries as a group to meet their home demand for steel by 1980, on the basis of the consumption forecasts of 21.8 million tons per year. The 90 per cent contribution from their internal production indicated in Chapter 3, appears to be a target well within their reach.

Middle East

It was not possible to indicate the trends of steel production and apparent consumption for this region in Chapter 3, since the statistical sources did not distinguish adequately between the Middle East and the rest of Asia. On the basis of figures available for 1965, an approximate estimate of current steel consumption in this region would seem to be 3.5 million tons per year.

Only Egypt and Israel have existing crude steel capacity of any significance, and between them they account for about 20 per cent of the region's total consumption. The projects recorded in Chapter 2 would increase crude steel capacity in Egypt to between 1.5 and 2 million tons, and introduce steelmaking capacity of 1.4 million tons to Iran. In addition, Saudi Arabia, Kuwait and Syria may set up their own integrated steelworks. Thus it can be estimated that steel production in this region will exceed 3 million tons by 1980.

The consumption of steel should rise to between 5.5 and 6.0 million tons per year. The only individual country likely to reach self-sufficiency in this decade is Egypt, but the region is likely to produce as much as half its steel consumption from internal production by 1980.

Far East

It was necessary in Chapter 3 to treat the whole of Asia, including both the Middle East and the Indian sub-continent as a region. In this chapter, the Middle East has been discussed separately but the Indian sub-continent is again included with the Far East.

Apparent consumption in this region is currently about 15 million tons per year, of which India accounts for some 9 million tons. Existing production of crude steel is approximately 5.0 million tons in India plus a further 2.5 million tons in the rest of the Far East. The projects recorded in Chapter 2 would increase capacity for crude steel production to about 10 million tons, excluding India; expansion plans in India are so numerous that it is difficult to assess the level of output in 1980, but it is likely to exceed 10 million tons. On this basis, the Chapter 3 estimate of 14.3 million tons for the whole of Asia would seem to be rather low. The output of steel in India, Egypt and Turkey alone should reach this level, while production in South Korea, Thailand and the Philippines should total a further 5 million tons even if their expansion plans are only partially realised.

Thus the estimate made in Chapter 3 on the basis of the trend of production increases in the 1970's should perhaps be amended in view of the expansion projects planned by the individual countries. A very approximate estimate for the breakdown of production in Asia in 1980 can be made:-

		Million tons
Turkey	:	2.5
Middle East	:	3.0
India	:	10.0
Far East	:	6.0
TOTAL		21.5

Consumption in India alone is likely to rise to about 15 million tons, and in the rest of the Far East to over 10 million tons. Thus the estimate of consumption for the whole of Asia by 1980 made in Chapter 3 (33 million tons) may also be an under-estimate; a figure of 35 million tons would seem to be more realistic. These figures indicate that domestic production in India and the Far East could well increase its share of internal consumption to about 60 per cent by 1980, while the position in the whole of Asia could be very similar. This would be a substantial improvement on the trend recorded in Chapter 3, whereby the share of internal production by 1980 in Asia would be only 43 per cent of their steel consumption.

Europe

Future development cannot be satisfactorily considered in regional terms, since so few European countries are included in the survey. The estimates for production in 1979 given in Chapter 3 appear rather low by comparison with the projects recorded in Chapter 2. In Greece, it is planned to raise total crude steel capacity above 2 million tons by 1980, and Yugoslavia is planning to reach a capacity of 5 million tons by 1975. This is double the 3.6 million tons estimated from the trend of production in the 1970's and actual output should therefore be noticeably higher, enabling these European countries to maintain their 60 per cent contribution to consumption from their internal production.

General observations

Consideration of the expansion projects and of the factors affecting steel industry developments gives rise to a number of general conclusions, which are recorded below:-

(i) One of the problems for developing countries is the lack of a heritage of research on Direct Reduction processes, which may otherwise be the most suitable for the scale of plant often applicable in a developing country.

(ii) The pattern has been changing from the availability of a quality iron ore to the availability both of a reductant material and of power, as the dominant factor affecting development of a steel industry.

(iii) There is a strong bias in developing countries towards establishing a steel industry, in spite of possible adverse conditions, since it is a very useful start to industrialisation, with substantial male labour requirements and an output which is used in many other industries. Few industries can rival it on these grounds, perhaps only the cement and fertiliser industries.

(iv) The steel industry tends to be Government run in developing countries, since the market size in most such countries does not permit the economies of scale which are necessary to achieve commercial viability. The exception to this is the mini-mill, which may often be commercially viable provided a narrow range of product is acceptable. This type of plant may become much more widespread in future.

(v) The difficulty of achieving regional co-operation, for instance in Africa, to overcome the problem of restricted individual home markets, has already been mentioned. There is an alternative approach to this problem, which is not strictly within the scope of this survey - to promote co-operation with developed countries. This already occurs in terms of ore processing plants, which have been set up in some developing countries with overseas assistance from commercial concerns who provide a guaranteed market for a proportion of the plants output in return for financial assistance. It would be possible to extend this to the manufacture of semi-finished steel products in the developing countries for export to developed countries, where these would be finished and marketed. Co-operation of this kind would probably need to be at a governmental level, rather than on a strictly commercial basis. It could well solve the problem of setting up large-scale steelmaking operations without a big enough home market to absorb the finished products.

APPENDIX I - UNIDO STEELWORKS STUDY

Questionnaire

Status of works

The information sought does not refer to steelworks in existence and operating at the end of 1969, except insofar as there are schemes planned, or currently in hand, for their expansion. The steelworks plans about which we seek information are to be allocated to one of the following four categories.

Category 1	:	Now in progress (including works completed in 1970)
Category 2	:	Agreed upon but not yet started
Category 3	:	Planned but not yet agreed
Category 4	:	Considered for implementation in the 1970's but not yet planned in detail.

Units to be employed

If the tonnages given are not in metric tons, please state unit used. All monetary sums should be in either local currency or the equivalent in United States dollars.

Please indicate Country or State:

		Comments
A. Location or Proposed Location of Works:		
B. Category of Works: (please indicate)	1 2 3 4	When production due to commence:-
C. Raw materials: Please indicate which are to be used and state source, if known.	Iron ore (Lump/fines/ oxide pellets) Pre-reduced iron pellets Steel scrap Coal Coke Limestone Others	Fe grade:
D. Energy supplies to steelworks: Please indicate which are to be used and state source if known.	Coal Fuel oil Natural gas Electricity Thermal Electricity Hydro Others	

		Comments
E. Processes: Please indicate which are to be used, the sizes of plant items and/or their annual outputs	Ironmaking: Blast furnace Electric smelting Direct reduction Steelmaking: Basic oxygen furnace Electric arc Others Casting: Ingot (state size) Continuous (state size) Rolling: State types of mills to be installed	

	Product*	Tons per annum	Comments
F. Outputs: Please indicate planned output for each item or group of items and their present source of supply.			(Include notes on present sources of supply where appropriate)
	Heavy plate		
	Light plate		
	Wide strip		
	Narrow strip		
	Heavy sections		
	Medium sections		
	Light sections		
	Quality bars		
	Reinforcing bars		
	Coiled rod		
	Straight rod		
	Tube and pipe		
	Ingots		
	Slabs		
	Blooms		
	Billets		
	Others		

* Normally defined as:-

Heavy plate:	Over 2 metres wide or over 12. 5 mm thick.
Light plate:	Up to 2 metres wide and up to 12. 5 mm thick.
Wide strip:	Over 600 mm wide, up to 3 mm thick.
Narrow strip:	Up to 600 mm wide, up to 3 mm thick.
Heavy sections:	Over 35 kilograms per metre length.
Medium sections:	From 15 to 35 kilograms per metre length.
Light sections:	Under 15 kilograms per metre length.
Bars:	Over 12. 5 mm diameter.
Rod:	Up to 12. 5 mm diameter.

Please indicate where other definitions are used

	Product	Home Sales t. p. a.	Export Sales t. p. a.	Export Sales Principal Countries
G. Markets: Please indicate expected or probable distribution of products to be made.	Heavy plate			
	Light plate			
	Wide strip			
	Narrow strip			
	Heavy sections			
	Medium sections			
	Light sections			
	Quality bars			
	Reinforcing bars			
	Coiled rod			
	Straight rod			
	Tube and pipe			
	Ingots			
	Slabs			
	Blooms			
	Billets			
	Others			

		Estimated Expenditure	Comments
H. Capital cost* of project: Please give estimates of expenditure on steelworks and such other associated works as form part of project.	<u>Steelworks</u> Plant and services Buildings Civil Engineering <u>Associated Works</u> Roads Railways Water supply Power station Power transmission Harbour/Docks Training/Schools Town Others		
		Amount	
J. Capital Financing of Project: Please give details of sources of funds.	<u>Public sector</u> International loans (specify source): Government loan Government equity Public loans <u>Private sector</u> Equity funds Loan funds Plant manufacturers' credits Advance sales		

* If possible: please state if design, engineering, erection and commissioning costs are included; please indicate foreign exchange requirements.

K.	
Please describe any associated capital projects for which costs are given under H.	
Please give details of any agreements for technical aid.	
Please give details of any planned subsidiary industries to utilise steel output.	
Any other relevant information.	

APPENDIX II - REGIONAL CLASSIFICATION OF COUNTRIES SURVEYED

1. North Africa	:	Algeria Libya Morocco Sudan Tunisia
2. West Africa	:	Cameroons Dahomey Gambia Ghana Guinea Ivory Coast Liberia Mali Mauretania Niger Nigeria Senegal Sierra Leone Togo Upper Volta
3. Central Africa	:	Angola Central African Republic Chad Congolese Republic Malawi Mozambique Swaziland Zambia
4. East Africa	:	Burundi Ethiopia Kenya Madagascar Mauritius

	:	Rwanda Somalia Tanzania Uganda
5. South America	:	Argentina Bolivia Brazil Chile Colombia Ecuador Guyana Paraguay Peru Surinam Uruguay Venezuela
6. Central America	:	Barbados Costa Rica Cuba Dominican Republic Guatemala Haiti Honduras Jamaica Mexico Nicaragua Panama Salvador
7. Middle East	:	Bahrain and Trucial States Egypt Iran Iraq Israel Jordan Kuwait Lebanon Saudi Arabia Syria Yemen
8. Far East	:	Burma Cambodia Hong Kong Indonesia Korea (South) Laos Malaysia

	:	Papua and New Guinea Philippines Singapore Taiwan Thailand Vietnam (South)
9. Indian sub-continent	:	**Afghanistan Ceylon India Pakistan**
10. Europe	:	**Cyprus Greece Ireland Turkey Yugoslavia**

APPENDIX III

SCHEDULES OF STEEL WORKS PROJECTS

CONTENTS

Country ALGERIA

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Million)
STE NATIONALE DE SIDERURGIE	El-Hadjar (Annaba)	Iron ore	Ouenza (local)	Nil	1	1972	LD Steelmaking (2 x 70T converters)	0.6-0.7	0.6-0.7				1.83 Algerian Dinars (0.3 foreign credit)
		Coke	imported				Slab continuous casting	0.5					
		Oil	local			1971	HR Mills (flat products)	0.6-0.7		Plate, sheet	450-550		
		Natural gas	local			1973	CR Mills (flat products)	0.150		Plate, tinplate, galv. sheet	150		
					2	1975	Second Blast furnace	1.1	1.55				
							Third 90T converter	1.0-1.2	1.6-1.8				
							Flat continuous casting		(1.0)				
							Billet continuous casting		(0.5)				
							Seamless tube plant	0.08		Seamless tube	80		
							Bar & section mill	0.4		Merchant bars & light sections	400	-	
							HR expansion		(1.3-1.6)	Plate, sheet & strip	900		
							CR expansion		(0.7)				

Country LIBYA

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
	Not yet decided	Iron ore Steel scrap Limestone Natural gas Fuel oil	 Local Local Local Local	.02 (re-bars)	3	1975/76	Direct reduction using natural gas. Electric arc furnaces Continuous casting Small section mill Cold wire drawing mill	0.32	0.34	Rounds 6-60 mms Squares 10-39 mms Hexagons 10-50 mms Angles up to 60x60 mms Bars 5x25 mms up to 25x150 mms V-sections above 60 mms Miscellaneous sections in above sizes ½"-48" pipes spirally and longitudinally welded. All production mainly for home market		Small	70 million Libyan Pounds. (Government funds)

Country MOROCCO

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markers: Products	Markers: Target tonnage (thous. of tons)	Markers: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
	Nador	Iron ore - Coke - etc.	Rif deposits Imported	0.01	2	1971	-	0.12 in first stage 0.25 in second stage +0.02 tons of ferro-manganese	0.25	Sections Bars Tinplate galvanised sheet			US $ 120 000,000 (120m)

Country TUNISIA

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets			Capital Cost of Project (Million
										Products	Target tonnage (thous. of tons)	Present tonnage (thous. of tons)	
Societe Tunisienne de Siderurgie El Fouladh	Menzel - Bourghiba (El Fouladh)	Iron ore - Scrap - Coke - Limestone -	local local and imported imported local	0.12	existing								
					1	1971	Wire drawing plant	.015		Wire	.015	-	) 3.4) Tunisian) Dinars)
					3	1973	Electric arc furnace + continuous casting + rolling	0.05 0.06	0.170	Billets Wire rod	0.05 0.06		

Country LIBERIA

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
-	Buchanan - Grand Bassa County	Iron ore	local	nil	4	not decided	Blast furnace	.161	.161	light sections	31		US $ 115 million
		Coke	Europe or USA				LD Converter	.185	.185	coiled rod	36		
		Limestone					Continuous casting	.172	.172	straight rod	93		
										Markets would include the whole of the West African sub-region			

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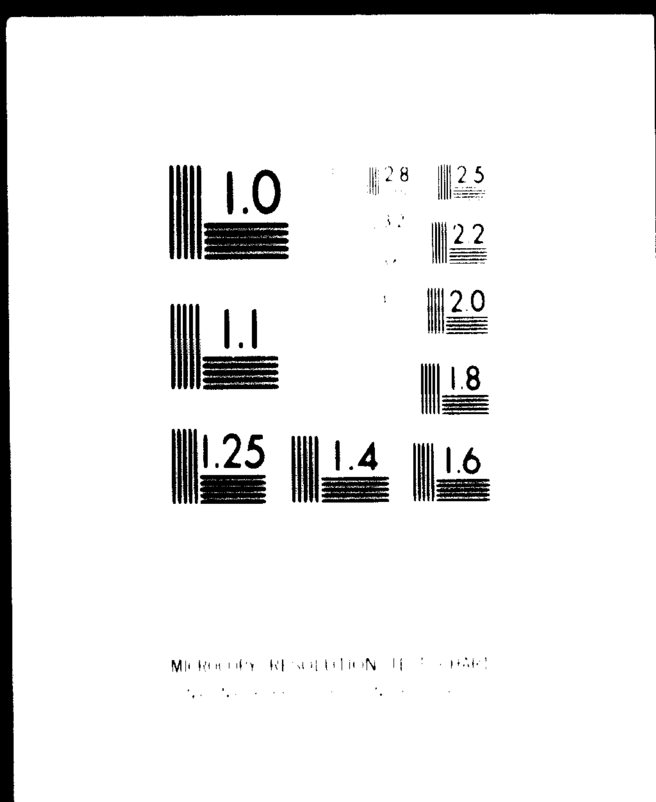

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Country MAURITANIA

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
-	Port Etienne	Iron ore - Coke - Limestone -	local imported from Europe + N. America local	nil	4	late 70's	Sinter plant Blast furnace LD converters Rolling mills	0.4	0.4	Rolled products	0.35	-	US $ 100 million

Country NIGERIA

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets	Capital Cost of Project (Millions)
	Not decided but possibly Onitcha (Eastern Region) or possibly primary facilities at Lokoja and rolling mills at Onitcha	Coal iron ore limestone	local (Enugu) local local		4	Start of con-struct-ion planned for 1974	Not decided	0.75	0.75	Reinforcing rounds merchant bars tubes sheets etc. etc.	for home and export markets	£150m (Sterling)
Wamac (Korf)	Ijeka	Billets Scrap	Imported local	-	4	-	electric arc furnaces + 2 strand continuous casting	0.1	0.1	rebars light sections wire rod in coil	for home markets	

Country ANGOLA

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
Siderurgia Nacional, Portugal	Samambo and Luanda	-	-	-	1 or 2	71/72	20 tons Electric arc furnace. (Leone-Tagliateri) Merchant bar mill	.12	.12	Merchant bars/ sections etc.			£6.3m.

Country CONGO (KINSHASA)

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
	Maluku (Inga)	Scrap Iron ore	Local & imported Local		2	72/73	Demag 50 ton electric arc furnace 4 strand conticast Rolling mill	0.15 0.1	0.3	rolled products sheets shapes galvanised sheets round bars			$100m.
							Italimpianti CR strip mill	0.08					
	Kimpako				-	1972							

Country MOZAMBIQUE

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
Companhia de Uranio de Mozambique	Beira	Iron-ore Coal	local (Tete district) local (Tete district)	0	2	1974		0. 25	0. 25	Mainly for export			

Country KENYA

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
<ENYA UNITED STEEL CO. LTD. KUSCO)	Miritini (Mombasa)	Scrap	local and imported	0.04 bars	3	1972	Electric arc Steelmaking Merchant mill	0.1	0.1 0.06	Wire rods Reinforcing bars Other light bars			
ɛMCO STEELWORKS <ENYA LTD.	Dandora (Nairobi)	Scrap Limestone Fe-Mn Iron ore Dolomite etc Fuel oil Electricity	local local imports imports imports local EAPTh. Co. Ltd.	Nil	1	Jul. 1971	Steelmaking 2 Electric arc furnaces of 30T. Ingot casting 200 x 200 Ploughing mill Bar mill	0.03	0.03	HR Strip Light sections Reinf. bars	H 1.0 ZE 1.0 T 2.0 H 6.0 ZE 4.0 T 10.0 H 15.0		K £1.5 all internal
					4	1980	Steelmaking		0.1	Coiled rod	H 1.0 ZE 1.0 T 1.0		

H = Home market
ZE = Zambia/Ethiopia
T = Total

Country UGANDA

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Million)
UGANDA DEVELOPMENT CORPORATION	Sukuku (nr. Tororo)	Iron ore (magnetite)	Sukuku	Nil	4	Early 70's	Steelmaking	0.1	0.1	Billets	Home market		US $ 20 Japanese aid

Country ARGENTINA (1)

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
SOMISA	San Nicolas (B. A.)	Pellets	Peru	1. 1	1	1972	Ironmaking 2nd BF 2900T/d	0. 9	2. 5	Rails & Sections	350	170	U. S. $295
		Iron ore	Brazil/Chile							HR strip	3, 000	1, 450	
		Coal	U. S. A. 95% Arga. 5%				Steelmaking 3 LD's of 150T	2. 5		CR prods.	1, 100	550	
		Semis	Imported				Continuous casting mach.	2. 5		Tinplate	220	110	
		Scrap	local										
		Limestone	local										
					4		Steelmaking	1. 5	4. 0				U. S. $230
PROPULSORA SIDERURGICA SA	Ensenada (Pto de la Plata B. A.)		Somisa plus imports		1	1973	Ironmaking BF	1. 2		CR sheet	550	350	U. S. $310
							Steelmaking LD 175T	1. 36		HR strip	1, 350	-	
							Roughing mill	1. 36					
					2	1975	Steelmaking LD	2. 5 total	2. 5				U. S. $175
							Roughing mill	2. 5 total					
							HR plate mill						
							CR sheet mill	0. 3 to 0. 7					
					2	1976	2nd BF	1. 2	2. 5				

Country ARGENTINA (2)

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets			Capital Cost o Projec (Millio
										Products	Target tonnage (thous. of tons)	Present tonnage (thous. of tons)	
ACINDAR	Rosario and Villa de la Consti-tucion (Santa Fe)	Coke, scrap Semis Ferro alloys	local local local	0.125	4		Continuous casting Steelmaking LD	0.8 0.8	0.8	Forgings Bright bar Wire rod Welded tubes	800	-	
DALMINE SIDERCA SA	Campara (B. A.)	Ferro alloys Scrap Pig iron	local local imported	0.3	1	1970	Steelmaking Electric arc furnace 50 T	C.1	0.3	Seamless tubes	200	150	
ESTABLICIMIENTOS SIDERURGICOS SANTA ROSA	La Tablada (B. A.)	Ferro alloys Scrap Semis	local and imported local local	0.19	4		Steelmaking Electric arc furnace 40 T			Quality steels Bar Forgings	 140 150	 140 150	
GURMENDI SA	Avellaneda (B. A.)	Semis HR coil	local and imported	0.3	1		Ironmaking direct reduction Steelmaking LD Continuous casting	0.3	0.3	Light bars and sections	330	240	

Country ARGENTINA (3)

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Million
ACERIAS BRAGADO-LUCINI SACIF	Bragado (B. A.)	Scrap Semis Ferro alloys	local local and imported	0. 133	1		Steelmaking Continuous casting	0. 2	0. 2				
ACEROS OHLER SA	Valentin Alsina (B. A.)	Scrap Ferro alloys Ingots	local imported	0. 043	4		Steelmaking	0. 1	0. 1	High C.Si steels Plate			

Country BRAZIL (1)

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Million)
COMPANHIA SIDERURGICA NATIONAL (CSN)	Volta Redonda			1.4	1	1973			1.7	HR Strip			US$ 9[illegible]
					2	1975			2.5	CR Strip			20[illegible]
					3	1980			4.0	Plate Galv. plate Tinplate			
COMPANHIA SIDERURGICA PAULISTA (COSIPA)	Cubatao (Sao Paolo) and Piacaguera			0.88	1	1972	Steelmaking LD		1.0	Plate			90
					2	1975	Steelmaking LD		2.0	HR Strip			29[illegible]
					3	1980			3.4	Slabs			
USINAS SIDERURGICAS DE MINAS GERAIS (USIMINAS)	Ipatinga & Interdente Camara (Minas Gerais) Belo-Horizonte			0.83	1	1975	Steelmaking LD	1.8	1.8	Plate Strip HR Strip CR			7[illegible]
					3	1980	Steelmaking LD Cold Strip mill at Belo-Horizonte						235
ACOS ANHAGUERA SA	Mogi das Cruzes			0	1			0.2	0.2				
CIA SIDERURGICA DA GUANABARA	Rio de Janeiro (Guanabara)			0	2	1976	Steelmaking LD	1.0	1.0				420
					4	1980	Steelmaking LD	1.0	2.0	Exports			

Country BRAZIL (2)

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
GERDAU SIDEURGICA RIO GRANDENSE	Rio dos Sinos (Guanabara)			0	1	1975		0.25	0.26				
					2	1980	Steelmaking LD		1.0				
USINA SIDERURGICA DA BAHIA (USIBA)	Salvador (Bahia)	Gas	Aratu		1	1972	Ironmaking HyL direct reduction			Bars Sections Wire Rod			CR $ 22
							Steelmaking by electric arc furnace	0.2					
					2	1974	Bars & Section mill Billet cont. cast	0.23	0.3 0.25				
ACONORTE (GERDAU GROUP) COSINOR	Recife (Pernambuco)			0.032	1	1976	Steelmaking Bar & wire rod mill	0.12 0.3		Merchant bars & wire rod	220	70	
METANING CO.	Parapeoba Valley (Minas Gerais)				3		Ironmaking by direct reduction						
							Steelmaking LD	2.0					US$9
							Medium & heavy section mill	0.5					
SIDERURGICA BARRA MANSA	Barra Mansa			0	1	1970	Steelmaking BF	0.11	0.11				

Country BRAZIL (3)

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost Project Millions
CIA SIDERURGICA DE AMAZONAS (SIDERAMA)	Manaus					1973 1976	Bars & Sections mill	0.06 0.12					
							Steelmaking						US$ 7.[illegible]
COMPANHIA FERRO E ACO DE VITORIA	Cariacico				1		Electric arc steelmakg.	0.08 (1st phase)					1st ph[illegible]
							Rolling Mill	0.170					US$5.[illegible]
COMPANHIA METROPOLITANA DO ACOS					1 2		Steelmaking GHH Sterkrade Continuous casting Merchant bar mill	0.13 0.13	0.26	Rod Bar Sections			
USINA SIDERURGICA MENDES JUNIOR	Juiz de Fora (Minas Gerais)			0.15	1	1974	Ironmaking SL/RN direct reduction Steelmaking GHH electric melting Bar & Rod mill	0.3 0.3					US$ 40
						1980	Steelmaking Ultimate expansion	0.6 1.2					

Country CHILE

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions US $)
COMPANIA DE ACERO DEL PACIFICO (CAP)	Huachipato nr. Concepcion	Iron Ore Coking Coal	Local Local	0.66	1	1974	Ironmaking, 3rd BF Steelmaking, two 100 T. LD Continuous casting machines (two) Light section mill 3rd galvanising line Oxygen plant, 290 t.p.d. Limestone plant Iron ore mines development at Vallemar		1.0	Blooms Billets Bars Plates Sheets Galvanised Plate Tinplate			320 (180 by Europe Japan rest loc
					3	1976			2.0				

Country COLOMBIA

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
ACERIAS PAZ del RIO	Belencito	Iron Ore Coking coal Limestone	Paz del Rio (Boyaca)	0.3	2	mid 70's	Ironmaking BF Steelmaking LD CR mill		0.5	Strip Plate Sheet CR Sheet Wire Rod Wire Billets Slabs			
UNDER STUDY	Tibate nr Medellin				4		Integrated		0.3				

Country PERU

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
SOCIEDED SIDERURGICA DE CHIMBOTE SA (SOGESA)	Chimbote	Iron ore pellets Electricity Coke	Marcona River Santa Power Station local	0. 225	3		Ironmaking BF Steelmaking LD Strip mill	0. 25 0. 2	0. 5 0. 35	Strip, plate, sheet, galv. plate, tinplate, merchant bars	100		
NEW STEEL-WORKS	Marcona	Iron ore Pellets Coal Limestone Electricity	Marcona Australia Canada local Mantaro	-	4	1976 1978 1980	Ironmaking BF Steelmaking LD Continuous casting Same processes as above Same processes as above		1. 5 3. 0 5. 0	Ingots Slabs Blooms Billets Semis as above Semis as above	Japan USA Germy. Italy Exports As above		$600 51% of which is local

Country VENEZUELA

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
SIDERURGICA del ORINOCO (SIDOR)	Santo Tome de Guayana or Puerto Ordaz and Matanzas	Iron ore	local area	0.75	1	1972	Steelmaking		1.25	Merchant bars	96% of home mkt.	500 home mkt.	
		Natural gas	Aroca		2	1975	Ironmaking BF						
		Coal	imported				Steelmaking LD		1.5	Structural steel			
							HR and CR strip mills						
							Centrifugal tube casting			Seamless tubes	500 expts.	300 expts.	
							Sheet mill (1970)	0.7					
							Tinning line	0.65		Flat products			
					3	1980	Steelmaking		2.5 to 3.0				
2 NEW STEEL PLANTS		Iron ore Coal	local imported	Nil	4	beyond 1980	Steelmaking	5.0 each	5.0 each	Semis	Exports		US$ 1000 50% local source

Country CENTRAL AMERICA (EXCLUDING MEXICO)

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions
ALTOS HORNOS DE CENTRO AMERICA	Agalteca (Honduras)	Iron ore (hematite) Charcoal Limestone	Agalteca local local	Nil	3	1972	Ironmaking, charcoal firing blast furnace Steelmaking LD Continuous casting billet mill	0.125 to 0.150 0.113 0.1	0.125 to 0.150 0.113 0.1	Billets	Central American Market 100		$37.5 Mexico2' rest loca of which U.S. sup pliers $18.0
					3		Second phase bar mill						
ALTOS HORNOS DE CENTRO AMERICA (alternative project)	Golfo de Fonseca (Honduras)	Scrap	local and imported	Nil	3	1972	Steelmaking electric arc	0.1	0.1	Billets	Central American Market		
COSTA RICA OFICINA DE PLANIFICACION (alternative project)	nr. Puntarenas (Costa Rica)	Titani ferrous magnetite Charcoal	local local	Nil	3		Ironmaking, direct reduction Steelmaking electric arc Continuous casting billets Bar mill	0.191	0.191	Billets Merchant bars Wire rod	Central American Market		$37.5 50% appr foreign

Country MEXICO (1)

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions
ALTOS HORNOS DE MEXICO SA (AHMSA)	Monclova Piedras Negras Mexico DF Lecheria	Coking coal Iron ore	Coahuila Cerro del Mercado Durango La Perla Coahuila El Encino (Jalisco)	1.5	2	1975	Steelmaking LD HR plate mill CR sheet mill Steel making LD		3.0	Semis, Slabs Billets, HR strip plate, Tin plate, Galvanized plate Bar products	Mainly Home Market		
	Las Truchas (Siderurgica Las Truchas SA) AHMSA subsidiary	Iron ore	Las Truchas	Nil	3	1975	Pelletising plant 2 BF ironmaking Steelmaking LD Continuous casting Continuous rolling mills	1.5	1.5				
						1980	Steelmaking LD	1.5	3.0				
COMPANIA FUNDIDORA DE FIERRO Y ACERO DE MONTERREY	Monterrey	Coking coal Iron ore	Coahuila Cerro del Mercado Durango La Perla Coahuila El Encino (Jalisco)	0.837	1	1970	Steelmaking LD CR sheet mill Galvanising plant		1.0				$30
					2	1975	Steelmaking		1.5				
					3	1980	Steelmaking		2.0				

Country MEXICO (2)

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project Millions
HOJALATA Y LAMINA SA (HYLSA)	Xoxtla Puebla	Iron ore Natural gas	El Encino (Jalisco) NE of the country	0.8	1	1970	Iron making HyL Steelmaking arc furnace Rolled products	0.33 0.264 0.3	0.33 0.264 0.8	Bars Sections Wire rods			$27.0
					2	1975	Steelmaking		1.5				
					3	1980	Steelmaking		2.0				
COLIMA STATE GOVERNMENT	Colima	Iron ore	Peña Colorada	Nil			Steelmaking		1.0				
TUBOS DE ACERO DE MEXICO SA (TAMSA)	Veracruz	Iron ore Natural gas	El Encino (Jalisco) NE of country	0.5	1	1970	Iron making HyL 350T		0.5	Seamless tubes			
					2	1975	Steelmaking		0.6				
					3	1980	Steelmaking		0.8				

Country EGYPT

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Million
EGYPTIAN IRON & STEEL	Helwan	Iron ore	local Baharia & Aswan	0.30	1	1975	3rd or 4th Blast furnaces LD Steelmaking - 2 x 100-ton converters Continuous casting Galvanising plant	0.80	(1.75) 2.00	HR strip CR sheet			
NATIONAL METAL INDUSTRIES	Cairo			0.05			Electric arc furnace (30-ton) Continuous casting		0.16	HR sheet Tinplate			
EGYPTIAN COPPER WORKS	Alexandria			0.065			Electric arc furnace Continuous casting		0.15				

Country IRAN

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost o Projec (Millio
NATIONAL IRANIAN STEEL	Isfahan			Nil	1	1971	Blast Furnace LD Steelmaking		0.70				
						1974	Expansion to:		1.40				

Country SAUDI ARABIA

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions
GENERAL PETROLEUM & MINERAL ORGANISATION	1) Dammam	Scrap or Sponge Fe	imported local	Nil	3	Not known	Electric arc (if scrap based)						
		Coke	imported or locally manufactured				Continuous casting (80 x 80)			Billets	45		
		Limestone	local				Rolling mills (including Djeddah)			Reinforcing bars and rod	500		
	2) Djeddah - expansion project for existing mill, (45, 000 t. p. y. current capacity).												

Country KOREA (SOUTH)

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
POHANG IRON & STEEL CO.	Kyung Sang	Iron Ore	Up to 50% Korea - Balance - Australia & India	Nil	1	1973	Blast furnace	0.95	0.95	HR Strip	600		$163 (+ $125 Local currency)
							Steelmaking LD	1.01	1.01	Plate	185		
										Billets	141		
		Steel Scrap	Domestic										
						1972	Rolling Mills	0.925	0.925				
		Coal	U.S.A., Canada, Australia		2	1974	Expansion (Phase II)		2.4				
						1980	Expansion (Phase III)		5.0				
		Limestone	Domestic										

Country MALAYSIA

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project Millions
MALAYAWATA STEEL BERHAD	Prai			0.130	1	1970	Blast furnace Wire rod mill	0.07					$21
						1972	10-ton Electric arc furnace	0.02	0.150				$11
							Continuous casting Hot coil processing	0.07					
					2		Electrolytic tinning line						

Country PHILIPPINES

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
LIGAN NTEGRATED TEEL MILLS	Iligan	Iron Ore Coal	Mainly imported	Nil	3	1974	Blastfurnace LD Steelmaking	(0.35)	(0.35)	Merchant bars Pipe Skelp Sheet			$120
LIZALDE OLLING MILLS	Balayan				3	1973	Blast furnace LD Steelmaking Blooming mill						
ARSTEEL ORPORATION	Limay						Billet Mill	0.2					
(N.B. Board of Investments are considering an alternative joint project in lieu of the independent plans indicated above:-													
Not Known	Not Known	Iron Ore Coal	Mainly imported	Nil	4	1970's	Blast furnace LD Convertors Continuous casting Slabbing mill	1.5					

Country TAIWAN

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
OFFICE FOR STEEL MILL PROJECT	Kaohsiung	Iron Ore Coal Limestone	Imported -primarily Australia Domestic	Nil	4	1976	Coke Oven plant Sinter plant Blast furnace LD Steelmaking Continuous casting Rolling mills	0.72 0.55 1.15 1.30 1.30 900	1.30	Rods Bars Sections Billets Total	110 290 400 300 1,100	Nil	Foreign currency $164 Local currency $76
							Steelmaking		2.30				Approx $80

Country THAILAND

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
SIAM IRON & STEEL CO.	Ta Luang Saraburi	Iron ore Scrap Charcoal Limestone	domestic	(0. 04)	1	1970/78	Electric Iron Smelting Electric arc Continuous casting Merchant and bar mill	(0. 150) (0. 150) (0. 075) (0. 155)	(0. 150)	Sections Bars and Rods	165	Phases I & II	$22. 4
		Scrap	U. S. A. & Australia				Blast furnaces LD converters	(0. 400)			230	Phases III & IV	$54

N. B. Figures shown in brackets have been estimated from news reports and were not supplied by the Siam Iron and Steel Company Limited.

Country CEYLON

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project Million Rs.
EYLON STEEL ORPORATION	Oruwela	Scrap	local and imported	Nil	3	1974 ph. 1	Steelmaking electric arc furnace	0.065	0.065	Narrow strip	0.9		Plants & services 55
		Limestone	local				Billet cont. casting 80 x 80 mm.			Light sections	14.2		Civl Eng. 55
										Quality bars	5.7		Roads 5
										Reinforcing bars	43.0		115
		Ferro-alloys	imported			ph. 2	Steelmaking		0.108	Coiled rod	37.0		Total of which:
										Wire + wire products	20.0		Soviet loa 50
										Ribbed twisted bars			Gov. loa 50
													Other 11
													Total 115

Country INDIA (1)

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project Millions
HINDUSTAN STEEL LTD.	Rourkela (Orissa)	Iron ore	Barsud Barodjanda	1.8	3	Early 70's	Steelmaking LD		2.5	HR Sheets			
							CR grain orientated sheets (Si-steel)			plus coil		850	
										CR strip		210	
			Banspani		4		Expansion licences for:			Plates		185	
							Galvanised sheet	1.6		Tinplate		26	
							Electrical sheet	0.05		Welded tubes		100	
							Tinplate	1.5					
	Durgapur (West Bengal)	Iron ore	Balana and local	1.6	4		Steelmaking LD		3.4	Bars		321	
							Expansion licence for			Railway track and Heavy sections		60	
							Saleable pig iron	0.3					
							Ingots	1.6					
							Merchant bars	2.4					
							Sleepers	0.075					
							Fish plates	0.011					
							Sections	0.2					
							Forging blooms	0.028					
							Billets	0.042					
							Wheels & axles	0.093					
							Tube	2.5					

Country INDIA (2)

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
HINDUSTAN STEEL LTD. (Continued)	(Durgapur) Alloy steel works	Scrap Fe-alloy Si-Cr Si-Cr	local Fe-alloy Corpn. Orissa and Andhra Pradesh	0.1	4	Early 70's	Steelmaking electric arc furnaces 60T Continuous casting Section mill 1m. strip mill		0.2 to0.3	Sections Bars and rods Strip all stainless steel	Home market		Collaboration with Atlas Steel (Canada)
	Bhilai (Madhya Pradesh)	Iron ore Expansion	Rajhara Dalli mines	1.7	2	1971	Ironmaking BF Steelmaking LD		2.5	Bars	Home market	390	130 crores plus iron ore mine exp.
		Coal Limestone Manganese Dolomite	Bokaro Jharia Korba Nandini (Madhya Pradesh) Balaghat (Madhya Pradesh)		3	1976 to 1981	Ironmaking BF of 1719m.^{3} Steelmaking LD 2 x 100 tons Continuous casting 3 x 2 strand 1000-1800 mm. Plate mill 4 m.	0.7	3.6	Railway track and heavy sections Plate	700 ship-building Heavy engineering	390	20 crores

Country INDIA (3)

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
HINDUSTAN STEEL LTD. (Continued)	Bokaro (Bihar)	Iron ore Scrap Coal Limestone Dolomite Quatsite Manganese Ore Electricity	Kiriburu Maghata-buru (Bonai Range of Orissa) local Hazaribagh (Bihar) Bhavanathpur & Kuteshwar Hiri (Madhya Pradesh) Santapur Barbil (Orissa) Damodar Valley	Nil	1	1973	Ironmaking BF 3 x 2000m.^{3} Steelmaking LD Converter 4 x 100 Ingot casting 15.6 to 30T Slabbing mill 1250 mm Ø roll Strip mill 2m. wide CR Mill 2m. wide	1.7	1.7	HR strip & sheet CR strip & sheet Galv. and Al sheets	789 425 150 All for Home Sales		700 crore of which 300 are external (Russian Technical Aid)
					2	1976	Ironmaking BF 2 x 200m.^{3} Steelmaking LD 1 x 100 T. and 2 x 250T. Finishing mill roll Ø 800mm. CR mill - 1.7m. wide		4.0	HR strip & sheet CR strip & sheet Galv. and Al sheets	1520 1000 600 All for Home Sales		

Country INDIA (4)

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
INDUSTAN TEEL LTD. Continued)	Visha khapatnam (Andhra)	Iron ore	Bailadila	Nil	4	1978-79	Ironmaking			Structural sections and shapes	Home sales especially South India and Exports		750 to 800 crores
		Scrap	local										
		Coal	Ramgarh Talgaria Mohuda (Jharia) Churtha Katkone (Madhya Pradesh)			5th Plan	BF 2000m.3 Steelmaking LD 250t.	2.0	2.0				
		Limestone	Jaggyapet (Andhra Pradesh)										
		Manganese Ore	Tunkur (A.P.)										
		Dolomite	Khamam (A.P.)										

Country INDIA (5)

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
HINDUSTAN STEEL LTD. (Continued)	Hospet	Iron ore	Domamalai Ramandurg (Mysore)	Nil	4	1978-79	Ironmaking	2.0	2.0	Structural sections and shapes	Home sales in South India		750-800 crores
		Coal	see Vishakhapatnam project			5th Plan	BF 2000m.[3] Steelmaking LD						
		Limestone	Bagalkote										
		Manganese ore	Tunkur (Andhra Pradesh)										
		Dolomite	Khamam (A. P.)										
	Salem (Madras)	Iron ore	Kanjimalai (Madras)	Nil	4	1978-79	Ironmaking DR	0.250	0.250	Special steels	Home sales		180 crores
		Scrap	local			5th Plan	Steelmaking Electric arc and LD						
		Lignite char	Neyveli										
		Limestone	Jaggyapet (Andhra Pradesh)										
		Manganese	Tunkur (A. P.)										
		Dolomite	Khamam (A. P.)										

Country INDIA (6)

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions) 1 crore = 10^7 Rs.
'ATA IRON & TEEL CO. LTD. TISCO)	Jamshedpur (Bihar)	Iron ore (company owned mines) Coal (Co. owned mines) Limestone & Dolomite (Co. owned mines)	Noamundi Gorumahisani Ioda (Bihar and Orissa) Jaria basin Birmitrapur local	2.0	3	Early 70's	Expansion and modernisation of Melting Shop (LD Steelmaking) Rolling Mills	0.3-0.4	2.2	Semis Light & med. sections Tube semis Sheets Railway Plates Heavy sections Wheels, tyres Axles	Home market	40[illegible] 45[illegible] 162 15[illegible] 101 9[illegible] 4[illegible] 2[illegible]	Plant & Services 96 crores Buildings 8 crores Power trans. 1 crore
NDIAN IRON & TEEL CO. LTD. ISCO)	Burnpur (West Bengal) Hirapur Kulti	Iron ore (company owned mines) Coal Limestone	Goa Monokharpur Raniganj basin Jaria basin Ramnagar Chasnalla (Bihar) Bisra (Orissa) Satra (Madhya Pradesh)	1.00	3	Early 70's	Steelmaking electric arc 40T. Continuous casting	0.3	1.3	Tubes Castings Wire rod Light bars Light sections Sheets Galvanised Sheets Plates	Mostly home sales 0.3 increase planned		24 crores
					4	1974	Steelmaking		2.5				

Country INDIA (7)

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
'IYSORE IRON & ;TEELWORKS	Bhadravati			0.08	1	1970 delayed	Ironmaking	0.12	0.2	Sections Rods & strip Cast iron	Home sales	29 13 61	
'OLY STEEL	Bhavangar (Gujarat)				1	1st phase	Steelmaking		0.05				9.6 mill. RS
					3	2nd phase	Steelmaking		0.075				50 mill. RS
						3rd phase	Steelmaking Rolling mill	0.1	0.2				
BIRLA	Patratu (Bihar's Hazribagh				1		Steelmaking Electric arc 10T. Continuous casting Rolling mill	0.05					40 crore
RATHI ALLOYS & STEELS	Ghaziabad						Steelmaking	0.05		Special steels			8.55 mi RS
CHOW GULE & CO. of GOA	Bellary (Hospet)				3		Ironmaking SLRN process	0.3					12 crore
BHARAT STEEL TUBES LTD.	Ganaur (Haryara) and Ganadran (Punjab)	Scrap	local		4		Ironmaking D-R HR Strip	0.15	0.3	Tubes		120	

Country INDIA (8)

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
PRABHUDAS RANJI MEHTA GROUP	Bhavnagar				4		Billet making plant Wire rod mill			wire rod			2 crores
STEEL COMPLEX LTD.	Arkonam (Kerala)	Scrap	local		4	1978	Ironmaking D-R Continuously cast billets		1st stage 0.05 2nd stage 0.1 3rd stage 0.2				
STATE INDUSTRIAL DEVELOPMENT CORPORATION	Hissan (Haryana)				4		Ironmaking		0.1	Pig iron			6.7 mill RS

Country PAKISTAN

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
PAKISTAN STEEL MILLS CORPORATION	Buleji North of Karachi (West Pakistan)	Iron ore	Australian Afghanistan Imports	Nil	1	1972	1st phase	0.1		Sheet			$150
					2		2nd phase		0.5	Heavy sections			
		Coal			3		3rd phase		1.0	Re-rolling billets			
	Karachi					1971			0.2	Special steels			$14
CHITTAGONG STEEL MILLS	Chittagong (East Pakistan)			Nil	1	1971	Open Hearth	0.15	0.15	Plate Sheet Merchant bars Galvanised plate & sheet			
					2	Early 70's	Steelmaking Plate mill Bar mill Galvanising line		0.25				

Country GREECE

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
HELLENIC STEEL CO.	Thessalon-iki			Nil			Electric arc HR mills	0.300 1.5	0.300				
NEW WORKS	Possibly at Thessa-loniki						Iron and steelmaking		2.0				

Country IRELAND

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
IRISH STEEL HOLDINGS		Steel scrap	Domestic and imported	0.076	1	1973	Electric arc - 30-ton vessel	0.06	0.135	Blooms	54		£3.2
										Sections	11		£0.99 Local currency
		Limestone	Domestic							Bars and rod	24		
		Pig iron	Imported				Modification to mills						

Country TURKEY

Name of Steel Company	Location of Works	Raw Materials	Source	Existing raw steel capacity in m.t.p.a.	Category of Project	Implementation date	Processes	Capacity of new plant in m.t.p.a.	Future raw steel capacity in m.t.p.a.	Markets: Products	Markets: Target tonnage (thous. of tons)	Markets: Present tonnage (thous. of tons)	Capital Cost of Project (Millions)
ISKENDERUN DEMIR VE CELIK FABRI-KALARI MUESSESESI MUDURLUGU	Iskenderun (3rd Iron & Steel-works)	Iron ore	domestic	Nil	1	1974	2 Blast furnaces	1.100		Narrow strip	20		£340 (Plus $70 associated local works) of which $263 under loan from U.S.S.R.
		Scrap	domestic & imported				LD Steelmaking - 2 x 130 ton converters	1.1	1.1	Light sections	100		
		Coal					Continuous casting			Reinforcing bars	210		
		Limestone					Billet mill	0.955		Coiled rod	300		
							Section mill	0.330		Billets	300		
							Wire rod mill	0.300					
EREGLI DEMIR VE CELIK FABRIKALARI	Karadeniz Eregli			0.50 (1969)	1	1970 1971	Expansion programme	0.70 1.0					
4TH STEEL-WORKS	Sivas				2	1970's	Steelworks						£T 1,000

We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards even though the best possible copy was used for preparing the master fiche

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