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SECTION III

ANALYSIS OF THE IRON AND STEEL INDUSTRY IN THE DEVELOPING COUNTRIES

have become popular. The countries in question are anxious to use their own raw materials rather than see them exported to the industrialized world and then be forced to pay premiums for finished steel products which they must import. The desire to use one's own resources at home is more than understandable and has given great impetus to the development of some type of steel industry wherever raw materials are available.

Another development which has taken place in the last few years is the beneficiation of the low grade ores by a number of processes. Thus, ore which was heretofore considered utterly uneconomical has in a very short time become an economic asset. Sintering and pelletizing plants have made use of very low grade ore, i.e., 25 to 35 per cent iron content. The problem involved here is the contruction of one of these plants in a developing country, for the capital required is substantial and is thus a deterrent.

Creation of Employment

The developing countries are still predominantly agricultural in their economies and have a fairly low per capital income. They want to make a transition from a predominantly agricultural economy to one that has a fair amount of industry. Further, they are under pressure from the population explosion and, consequently, wish to supply jobs for the ever growing numbers of people. Thus they look to industrialization as a solution, in part at least, of this problem. The establishement of a steel plant and all that goes with it, as well as the development of steel-consuming industries, has done much to provide employment where it has been successfully carried out. Further, it is necessary to train technicians to operate plants and factories and this will give the countries, in many instances for the first time, a pool of skilled labor and technical personnel upon which they can draw for

further industrial development.

Economic Considerations for Steel Plants in Developing Nations

The factors motivating construction of a steel plant, as we have observed, may be economic, social, or political, and in practically all cases decisions concerning steel investment cannot be made on the basis of one consideration to the exclusion of the others. In the final analysis, however, economic considerations should be dominant in these decisions, for the effectiveness of a steel plant as a tool of industrial development and social improvement depends on a number of economic prerequisites which must be satisfied if the project is to be successful. Consideration should be given to the following factors:

1) The size of the investment required to enter steel production makes capital availability one of the most important considerations, especially in the developing nations where sufficient investment funds are not generated internally and outside funds must be obtained.

2) The size of the market as determined by present steel consumption and the predictable future growth of demand should be studied to indicate the size of the steel plant to be installed and the steel product categories which are most essential.

3) Another consideration is whether or not the raw materials necessary for steel production can be obtained at a reasonable cost, either from domestic sources or from abroad. The quality and quantity of proven reserves at home and assured sources in other countries must be assessed.

4) Adequate supplies of power and water must be available, and both the quantities needed and their costs must be studied.

5) Adequate and economical transportation must be available, both for the movement and receipt of raw materials and the shipment of steel products to markets.

6) The available supply of labor and its adaptability to industrial production techniques must be determined. Consideration must be given not only to the requirements for production workers, but also to the supply of managerial and technical personnel, which in most cases must be obtained, temporarily at least, from the industrialized nations.

7) A suitable plant site must be chosen which, if possible, is favorably located in relation to transportation arteries, power and water supplies, raw material resources, steel markets, the labor force, and possibilities for future expansion. In addition, extensive professional planning must be devoted to the general layout of the plant and the selection of steel equipment best suited to the output planned and the raw materials available.

8) An estimate should be made of the possible production costs of the steel, the selling prices of its output, and the consequent competitive position of the country with regard to steel imports. These factors will be determined to a large extent by the degree to which the above-listed prerequisites are satisfied.

9) In the case of steel plants which are privately owned, consideration must be given to possible government assistance to the project by way of tax concessions, tariff protection, price guarantees, and purchase of steel products for national programs.

Capital Requirements

In the decision to construct its own steel plant, the developing country

is confronted with a serious problem in the matter of available capital. The means must be obtained to finance the large costs of equipment and construction which will vary depending upon the degree of integration which is planned for the new installation under consideration. A country that plans to expand an already existing steel industry can consider two kinds of mills: first, a fully integrated steel mill and, second, a smaller non-integrated operation. A country that chooses to build an integrated mill must make a further decision on the number of products it wants to produce, for an integrated mill which produces one or two products can operate economically on a smaller ingot tonnage than a mill which produces a larger range of products. In order to operate economically, finishing facilities must be employed for a fair amount of total time. If finishing facilities are installed for four or five products, ingot capacity must be commensurate with this and, thus, a larger plant will be required.

The exact tonnage necessary for a profitable operation will vary according to circumstances. It is possible, as can be seen from Mexican steel operations, that an integrated mill such as the Fundidora Steel Company in Monterrey can operate profitably on 300,000 tons of steel products divided among several categories. Obviously costs and prices which are obtained for steel products are going to determine the outcome. The Fundidora Steel Company, however, has a plant which has been built at a relatively low cost over a number of years and thus the capital outlay required was by no means as great as that which would be necessary for a new plant built from the ground up. In a case of a new plant where capital charges are high, particularly if this plant is large such as the one proposed for Bokaro in India, a sizeable production must be realized before the plant can operate profitably. It was estimated that the

mill which ultimately was scheduled to produce 4 million tons would not operate profitably until it produced 2.5 million tons. This is in great part due to the fact that the construction cost for the three phases varied from $522 per net ton of capacity installed to $311 per net ton of capacity installed in the third phase, while the second phase was $381 per net ton of capacity installed.

Thus it would seem that at first any integrated operation should confine itself to one or two products in order to operate economically, if crude steel capacity must be sufficient to strike a balance with the finishing facilities installed since they are particularly costly and must be operated for more than a small portion of the time. An illustration of this can oe had from a project which was contemplated in the New England section of the United States in the early 1950's. The mill was planned with a capacity to produce one million tons of crude steel, yet five or six different types of finished products were projected. This was a virtually impossible balance and the mill never materialized because one million tons would not sustain the required rate of operation for the number of finishing facilities that were planned.

If a country, on the other hand, wishes to install a smaller integrated steel facility, there are again several possibilities. First, it might think in terms of a relatively small operation such as the electric furnace type which would use scrap and a rolling mill for bars and small structurals. This would involve a relatively low capital investment, but would serve just one basic steel demand, namely, for bars. If, however, a country wished to attempt something more ambitious, it might well think of building the finishing facilities first and importing semi-finished steel so that with the investment in one facility there would be products available for sale. This is being done today in the Philippines where a mill for light flat products

such as cold rolled sheets, tin plate and galvanized sheets is being installed. The plan is to put the cold rolled finishing facilities in first and import hot rolled bands so that sales revenue will be forthcoming as soon as possible. After this a hot strip mill will be installed and slabs imported and, finally, the company will produce its own pig iron and steel. Thus, in a very short time the capital investment will begin to yield returns.

If a country plans to use local iron ore resources with a low iron content which must be beneficiated or concentrated in some manner, an additional investment is required for the contruction of facilities to perform this function. A taconite plant installed in the United States in Minnesota with an annual capacity to produce 7-1/2 million tons of usable ore, in the form of pellets, represents a capital investment of $300 million. Another plant, which was recently built in Canada to concentrate soft ores from their original 30 per cent iron content up to 66 per cent iron, represents a $200 million investment. These are perhaps extreme cases in terms of cost, yet plants such as these - even on a smaller scale - do represent considerable capital investment. If, however, a sintering plant is installed in place of a pelletizing plant, the investment can be considerably less. Here again, the quality of the ore which depends not only on its iron content but the various other elements contained therein, will affect the investment necessary to beneficiate this ore into a usable product.

Those developing countries with a limited capacity to produce steel, i.e., less than 250,000 tons, and plans to expand to 500,000 tons or more are obviously not considering a convertional integrated steel mill, but rather a smaller operation, perhaps an electric furnace with finishing facilities such as bar mills. In such cases, investment costs are far less than for an

integrated mill, but the cost of such a project could well be many millions of dollars. This amount of steel capacity will establish the country to a limited extent in the steel business, but it cannot supply the total steel needs of the economy in question. The same is true of those countries who at present have no steelmaking capacity, but plan to install some within the next few years. Their plans are limited and, even if fully realized, will not approach satisfaction of their total steel needs. In both these instances capital availability is a problem.

Ideally, the capital requirements for the steel plant should be obtained principally from sources within the country by issuing stock for sale to lending institutions, banks, insurance companies, and the general public. This insures interest in the support for the project by those most affected by the development of a steel plant, and also nullifies the possible ill effect which extensive outside borrowings might have on the country's foreign exchange position. However, developing countries are seldom, if ever, in a position to meet such capital requirements on their own. The reasons for this are many, but may be reduced to the relationship between savings and the funds available for investment. In an industrially and economically mature country, variations from the equality of savings and investment usually appear in the form of over-savings and/or under-investment. This, however, is not the case in a developing country where fluctuations most likely occur in the opposite direction, namely, savings that are not sufficient to maintain a significant level of investment. This can be attributed to a number of causes, principal among them being the low incomes and unequal distribution of wealth that are characteristic of many of the developing economies. For a major percentage of the population, this means that income is absorbed by everday needs, so that

savings are minimized. All this comes down to the fact that funds are not available to undertake large-scale investment programs such as steel mills. Thus, it becomes necessary to rely on outside sources for the required capital. Long-term capital financing is obtained from public and private lending institutions in the industrialized countries, or long-term credits are extended by the suppliers of the steel mill equipment. In either case, the loans must be on a long enough term and at low enough interest rates so as not to preclude economic results from the plant's operation.

Market Survey

A thorough market survey relating to its steel requirements should be employed by the developing country at the outset of its evaluation of the economics of domestic steel production. The market demand for steel should be assessed from three principal standpoints: (1) total demand, (2) demand for the various steel product categories, and (3) the likely rate of future demand growth. Such a survey will provide information about the country's current and possible future steel requirements, as well as the variety of steel products needed to satisfy them. On the basis of these findings, the capacity of the steel plant under consideration as well as its possible product-mix should be largely determined.

With respect to total steel demand, the principal factor to be determined is total domestic consumption. The possibility of export markets for a portion of the country's steel output should not enter significantly into the consideration, since for the developing country they do not constitute at the outset an assured outlet for its steel products. This is so because production costs may be higher than those of competing foreign steel from the developed nations, and also because there is currently an excess of world steel capacity and

production with consequent severe competition for international markets.

Having determined total steel consumption, its end uses must next be established. This involves an analysis of the steel-consuming industries within the country and the various types of steel products which they require, such as wire rods, merchant bars, shapes, structurals, etc. Not only must the variety of steel products consumed be determined but, also, the sizes and grades of these products and the tonnages used.

Nations whose economies are in a state of development often require a greater diversity of steel products than might be expected. A brief survey of the imports of eight countries which are contemplating entry into the steel industry, or expansion of existing facilities, shows that virtually all of them import ten categories of steel mill products including ingots and semi-finished steel, rails and track materials, heavy and light structural sections, wire rods, wire, strip, plates, sheets, pipe, tin plate and wheels and axles. The countries included are Colombia, Peru, Finland, Algeria, Iran, Morocco, the Federal Republics of Rhodesia and Nyasaland and Hong Kong. Table III-1 lists the steel product imports of each of these countries.

Based on the findings of the demand for individual steel products, the number of these products that the plant should produce as well as the sizes and quantities of each must be decided. More than likely, only a limited number of products will be economically feasible, because in the first place the capital requirements for an integrated plant satisfying the total range of needs are prohibitive and, secondly, because only small quantities of certain products and sizes will be demanded -- making production on an economical scale impossible. The product-mix of the plant under consideration should include only those items which are required in sufficient volume to permit efficient operation of the facilities installed.

Table III-1

1962 Imports of Steel Mill Products

By Product Groups -- Selected Countries

(thousand net tons)

Country	Total	Ingots and Semis	Railway Track Material	Heavy and Light Sections	Wire Rods	Strip	Plates	Sheets	Steel Tubes and Fittings	Wire	Tin-Plate	Wheels, Tyres and Axles
Columbia	165	5	0.4	9.0	1.0	8.0	22.9	64.1	30.3	3.8	20.3	0.2
Peru	137.3	0.2	5.2	37.9	3.0	5.8	31.3	19.5	16.1	5.7	12.3	0.3
Finland	588.3	69.6	57.2	103.3	7.5	16.2	254.6		65.0	15.1	10.0	4.8
Algeria	144.2	5.2	11.1	35.0	3.8	4.6	6.5	9.9	58.0	6.3	3.4	0.4
Iran	297.5	0.5	0.2	147.6	1.6	1.6	8.7	52.8	71.8	9.7	4.6	0.3
Morocco	133.4	0.6	8.7	55.6	9.2	1.4	8.1	12.0	8.4	6.7	22.5	0.2
Fed. of Rhodesia and Nyasaland	102.6	0.8	22.9	16.1	1.7	1.0	7.9	31.5	14.7	2.1	2.3	1.6
Hong Kong	320.2	3.1	1.5	162.0	6.8	3.3	27.1	46.1	26.5	13.2	30.3	0.3

Source: United Nations, Statistics of World Trade in Steel, New York, 1964, pp. 1-37.

Finally, in regard to the possible future growth of steel demand, an analysis should be made of such factors as population growth and the age distribution of the population, the trend in per capital income levels, and the per capital consumption of steel products. Cognizance should also be taken of the fact that the steel plant should act as a spur to the development of other industries, particularly those which use steel.

Raw Materials

The importance of adequate raw material supplies cannot be over-emphasized. Consequently, prior to its decision on building a steel plant, the developing country should undertake an intensive study of the availability, quality and cost of the raw materials used in steel production. Where local deposits of iron ore exist, a program of exploration and exploitation must be undertaken. Drilling as well as chemical and physical testing of samples will indicate the quantity and quality of the country's ore reserves. Studies to determine the nature of possible local supplies of steel scrap, coking coal, limestone, clay and dolomite must also be undertaken. The development and mining cost and the possible costs of the beneficiation and upgrading of local raw material reserves must be estimated, together with the costs of moving them to the planned location of the new facilities. These costs must not be so high as to preclude the economical operation of the steel plants. In this regard, the high cost of facilities for the beneficiation and concentration of low-grade iron ores must be noted. Although ores with iron content of 20-30 per cent, which heretofore were thought worthless, have been used very effectively after proper treatment, it is of little value to a country to know that it is possible to concentrate its ore supply if there is no installation to do this or if the costs of building such an installation are prohibitive.

If the use of local raw material supplies proves too costly, foreign sources might be resorted to with economic advantages. In this connection, it should be noted that the existence of local sources of ore, coal, etc., is not always a prerequisite to establishing a steel operation within a particular country. This is particularly true if the steel plant under consideration is planned for a coastal location.

The adoption of beneficiation on a wider scale and the shipment of high-grade natural ores by exporting countries has resulted in lower costs of transport, and the use of these ores allows more efficient steelmaking practice. Therefore, the primary consideration with respect to the raw materials for steel production, whether they be from local or foreign sources, is that their assured supply be adequate (i.e., the developing nation should plan in terms of at least a 25-30 year reserve of raw materials), their quality suitable, and their cost economically attractive.

Power and Water

Although the power and water requirements for steel production are in a sense raw materials, they differ significantly from those discussed above in that they cannot be imported and thus must be availabe in sufficient quantities in the steel-producing country. This means that the alternative of imports cannot be adopted if excessive costs are involved in developing adequate supplies of these resources. Steel production consumes extremely large quantities of water and electric power which must be supplied in an uninterrupted flow to guarantee continuous operation of the plant. As a result, it is preferable that they be provided from two independent sources, and consequently the country involved may have to undertake construction of electric power plants and water pumping stations. In its determination with respect to a new steel plant, the country

must assess its existing reserves of power and water in relation to the location of the intended plant site, and the quantities which can be used for steel production. Additional needs must then be estimated and provision made for their satisfaction. If adequate quantities cannot be provided, whether for natural reasons or because investment requirements cannot be met, the steel plant obviously cannot be constructed.

The electric power requirements for steel production vary both with the capacity of the steel plant and the type of facilities used. This is illustrated below by examples for five types and sizes of steel plants.[1]

1) W.W. Townie, Jr., and R.E. Presnell, Electric Energy Requirements for Steel Plants, United Nations Interregional Symposium on the Application of Modern Technical Practices in the Iron and Steel Industry to Developing Countries, Technical Paper A.20, 26 September 1963, pp. 7-11.

product. Because of the diversity and nature of the final output in this instance, Case 5 cannot be compared directly with Cases 1 through 4 but indicates the amount of electricity necessary to operate an integrated mill in the country in question.

Transportation

The transportation system of a country must be reviewed with emphasis upon the needs of the proposed steel plant. Of significance in this regard are existing highways, railroads, pipe lines, ports and waterways. The extent to which these various modes of transportation have been developed affects the mobility of workers, particularly in countries where the population is widely dispersed, and determines the costs of moving raw materials and of shipping finished products to markets. Water transportation offers the lowest cost for the shipment of materials in bulk, so that natural ports and inland waterways should be exploited to the greatest possible extent in connection with the planned steel operation. A sizeable capital investment may be required for the installation or expansion of port facilities, dredging operations, moorings, canal construction, etc., but it is essential to the future expansion of the industry that such measures be included in the country's overall plan with regard to steel production. Highway and railroad transportation should be studied with respect to total road and track mileage, the degree of its dispersion, its condition, and the amount of existing traffic. The requirements for rolling stock to move steel products and raw materials must also be assessed. The primary objective of these considerations is that the best use be made of the transportation facilities that are available within the country and that the required expansion and improvement of these facilities be undertaken, so that transportation costs per ton of finished steel product

delivered to the consumer are kept to a minimum. The costs of transportation within the plant must also be kept to a minimum by giving careful attention to the general plant layout and making use of the most modern materials handling equipment including pipe lines and conveyor belts.

Labor

The operation of a steel plant, depending on its size, requires either a limited or large number of skilled employees, as well as a trained supervisory force. However, in many of the developing countries there is a shortage of skilled labor and efficient management personnel. The economies of these nations are agriculturally oriented and levels of educational attainment and technical training are lower than found in the industrialized nations. This can be seen from Table III-2 which lists several indicators of educational attainment and industrial development for the industrialized countries and for selected developing countries which produce steel.

The degree of illiteracy found in most of the developing nations is high. The highest rate is in Algeria, listing 88 per cent of the population 15 or more years of age. Among the other developing nations listed, the lowest illiteracy rates were found in Israel at 6 per cent and Argentina at 14 per cent. The average rate for the developed countries is 4.5 per cent.

When one examines expenditures on education relative to national income, it will be noted that the rates for the developing countries are beneath the average rate of 4.8 per cent for the industrialized nations. The orientation of the economies of the nations listed is indicated by the percentage of their gross national products which is attributable to manufacturing. The average for the developed nations is 32.5 per cent, whereas the developing nations for which this information is available fall in the range of 10.7 to 21.3 per cent.

may be entered into with companies abroad. A number of other related factors must also be accounted for, particularly if workers must be recruited from areas distant from the plant site. In such cases the need arises to provide housing for personnel and their families, both domestic and foreign, schools, adequate medical facilities, recreation, etc. All of these requirements combine to make the labor supply one of the most important factors to consider in evaluating the economics of a steel plant.

Plant Site

Steel plant location should be based on a number of factors, the most important of which are the following: access to the country's principal steel market areas; the location of the most available concentrations of labor; the location of raw material resources; the supplies of electric power, water and natural gas; the availability of suitable railroad and highway transportation; access to deepwater transportation and protected anchorage; the land which is available and its cost. In most instances, a plant site which is favorably located in relation to all of these considerations obviously will not be available, and consequently it must be decided which factor or factors are to have precedence. One alternative is to locate on the tidewater near a large city. This is a customary practice and offers a number of advantages including ready access to a major market for steel products, access to raw material shipments from abroad, adequate water supplies, and the pool of prospective labor which lives in the city. Because of the close proximity of the plant to a major market area, shipping costs of finished steel products are kept to a minimum. On the other hand, should the country have deposits of iron ore which are inland, it may be preferable to locate near this ore and thereby lower shipping costs on raw materials. This is particularly the case if domestic sources of iron ore are low-grade and, therefore, are costly to transport.

Cost Estimates

Production cost estimates for the proposed steel plant can be obtained from an analysis of the estimated delivered prices of raw materials and the operating costs of the various departments in the plant. The delivered price of raw materials is derived by totaling a number of elements including the price at the source and the expenses of transportation, handling, port charges, various customs duties, and charges from other agencies. Operating cost estimates are derived from the actual experience of an existing plant with facilities similar to those planned. Estimated costs of the various products which are to be offered for sale can be determined by totaling these prices and costs and continuing the operation progressively through the various phases of production. The existing plant chosen for the operating cost analysis should neither be one which is exceptionally efficient nor one which is inferior in terms of what is generally considered a good average operation. It should be remembered that it takes a number of years for the operating costs of a new steel plant to approach an average level.

Government Assistance

Particularly in the developing countries it is often the practice for the government to be willing to grant generous tax exemptions to new industry. In most instances, these are along the lines of liberal depreciation allowances, although additional allowances may be granted on income and various other taxes. The existence of such allowances will often serve to improve the earning capacity of the proposed steel plant. Tariff protection and possible government purchases of steel products will also affect the feasibility of the plant and should be accounted for in its evaluation.

Case Studies of the Economic Considerations for a Steel Plant in a Developing Nation

The economic considerations for steel investment in developing countries have been set forth and discussed above as a series of general guidelines or essential requirements. In order to place them into a more perceivable context, and as concrete examples of their application, some of the more significant findings and conclusions of two economic surveys of proposed steel operations will now be set forth. The two steel plants to be reviewed are that of Companhia Siderurgica Paulista - "Cosipa," Sao Paulo, Brazil, and that of National Steel of Pakistan Limited, Karachi, Pakistan.

Case Study I: Companhia Siderurgica Paulista, Sao Paulo, Brazil

In 1953 the Companhia Siderurgica Paulista, Sao Paulo, Brazil was chartered to construct a steel plant in Brazil, whereupon preliminary work on the project was undertaken in the following areas: a) Selection and purchase of a plant site; b) Determination of soil and foundation conditions at the plant site; c) Determination of the available water supply and sources of electric power; d) Investigation of the source and characteristics of the major raw materials required for steelmaking; e) Study of existing dock and unloading facilities for the receipt of raw materials and their delivery to the plant site; f) Study of the alternative means for future unloading, handling and delivery of raw materials by direct docking of vessels at the plant site; g) A market survey of current and possible future demands for steel products; h) Assessment of the newly developing manufacturers, particularly in the Sao Paulo area; i) Engineering and preliminary design work on the layout of the proposed steel plant.

The Steel Market

As a result of the expansion that had taken place in the manufacturing industries, particularly in the Sao Paulo area, a market developed for greatly increased quantities of wide flat steel products. The automobile industry was the largest consuming group, but other fabricators were also in need of increased tonnages of wide steel coils and sheets.

A study of total Brazilian steel consumption revealed that although domestic production had been increased substantially between 1945 and 1956, large amounts of steel had to be imported. Domestic production increased from 205.19 thousand metric tons in 1945 to 1,375.4 thousand in 1956, but steel imports which were 385.5 thousand tons in 1945 still totaled 305.0 thousand in 1956.

A statistical projection of past production plus imports indicated apparent 1960 consumption of about 2.4 million tons and a 1965 figure of 3.2 million tons. However, since domestic production during the years carried forward was inadequate, and since restrictions on imports existed during the period, a demand figure of 2.5 million tons for 1960 and 3.5 million tons for 1965 was deemed reasonable for planning.

The current and proposed future capacities of Brazil's steel industry were then tabulated, and it became apparent that, on the basis of projected demand, a gap would develop between demand and domestic production. Even if all of the expansions planned by producers were effected, it was concluded that there would still be a deficiency of about 450,000 metric tons of ingots by 1960, and that the deficiency would amount to more than 900,000 ingot tons by 1965.

Concerning individual product categories, it was concluded that in addition to the deficit in the basic steel tonnage, Brazil was short in all types of

TYPICAL ELECTRIC-ENERGY USAGE FOR FIVE TYPES AND SIZES OF STEEL PLANTS

Plant Description		Item of Equipment	Output, Metric tons/year	Kwhr/ Metric ton	Million Kwhr/year
Case 1:	Plant producing 100,000 tons per year of merchant products from scrap using cold-melt electric furnace	Electric steelmaking furnace	115,000	550	63
		Merchant mill	100,000	80	8
		Plant and auxiliary power	-	-	13
		Total			84
		Average=840 kwhr/ton of product			
Case 2:	Plant producing 185,000 tons per year of merchant products from ore using electric smelting furnace without prereduction	Electric smelting furnace	160,000	2,200	352
		BOF (excluding oxygen)	200,000	20	4
		Merchant mill	185,000	80	15
		Plant and auxiliary power (including oxygen)	-	-	50
		Total			421
		Average=2,280 kwhr/ton of product			
Case 3:	Plant producing 185,000 tons per year of merchant products from ore using electric smelting furnace with prereduction with carbon	Electric smelting furnace with prereduction	160,000	1,200	192
		BOF (excluding oxygen)	200,000	20	4
		Merchant mill	185,000	80	15
		Plant and auxiliary power (including oxygen)	-	-	40
		Total			251
		Average=1,355 kwhr/ton of product			
Case 4:	Plant producing 185,000 tons per year of merchant products from ore using carbonaceous reduction to sponge iron in a kiln	Sponge iron plant	200,000	150	30
		Cupola	200,000	10	2
		BOF (excluding oxygen)	200,000	20	4
		Merchant mill	185,000	80	15
		Plant and auxiliary power	-	-	17
		Total			68
		Average=370 kwhr/ton of product			
Case 5:	Plant producing 730,000 tons per year of steel products from ore using blast furnace and open hearth processes	Blast furnace and coke plant	730,000	26	19 ✓
		Open hearth	1,000,000	27	27 ✓
		Rolling (bar, plate, sheet, structurals)	730,000	188	137 ✓
		Plant and auxiliary power	-	-	107
		Total			290
		Average=400 kwhr/ton of product			

(1)

KWH 290

Case 6) Plant producing 730000 t/year of steel ... from ...

The growth pattern of the steel industry on a world-wide basis is evident from the statistics of Section I and, from the projected plans, there seems to be little doubt that steel capacity will be expanded both in the industrialized and the developing countries over the next decade. It is the purpose of this section to outline and discuss the goals that have been set down, as well as the problems which must be met and solved in the realization of those goals.

There are a number of motivating forces which have inspired countries throughout the world to increase their steelmaking capacity The motives of the industrialized countries differ from those of the developing countries, and it will be part of our task to discuss both of these. Subsequent to this discussion, general economic considerations which relate to the expansion of steel production in the developing countries will be discussed and, finally, special problems which confront individual areas will be treated.

Motives Inspiring Expansion in Industrialized Countries

In the postward period from 1946 through 1952, there was a need to rebuild war-ravaged steel plants, for virtually every major steel-producing country outside the United States suffered considerable damage to its steelmaking facilities in the years of World War II In the United States and Canada, there was no wartime damage and, consequently, no rebuilding was necessary. Nevertheless, capacity was considerably expanded to meet domestic demand which had built up during World War II for consumer durable goods and also to supply steel to other parts of the world in order to help them in their rebuilding efforts.

The rebuilding was accomplished in great part over a period of seven

Case 1 represents a plant which produces 100,000 metric tons of merchant products per year. An electric furnace is used to melt steel scrap, and electric power consumption is about 84 million kwhr per year, or 840 kwhr per ton of finished product. This is relatively high considering that the raw material melted is scrap and not ore. Cases 2, 3 and 4 represent three types of small ore-based plants which produce 185,000 tons of merchant products per year. In cases 2 and 3 hot metal from an electric smelting furnace is used with steel scrap in an 18/20 ratio to produce steel in a basic oxygen furnace. However, in Case 3 the ore is prereduced and preheated before it is charged into the smelting furnace. It will be noted that this reduces electric power usage from 2,280 to 1,355 kwhr per ton of product. Case 4 represents an installation which is suited to areas where electricity is in short supply. Sponge iron briquettes are produced in a kiln, and are then melted with coke in a cupola. The hot metal is then charged into a basic oxygen furnace. This reduces the electric power requirement to 370 kwhr per ton of merchant product, which is 84 per cent less than in Case 2 and 73 per cent less than in Case 3. This indicates the possibilities for producing a given volume of steel products, in this instance 186,000 tons, using a wide range of electricity inputs. It does not mean that one plant is a lower cost producer than the others, or that total energy consumption for one plant is less than for the others.

The final example, Case 5, considers the electric power requirements for a conventional open-hearth steel plant which produces 730,000 metric tons of finished products. Whereas the final output in Cases 1 through 4 was limited to merchant shapes, the plant in Case 5 produces a greater variety of products many of which require more extensive rolling and consequently greater electricity input. An average of 400 kwhr of electricity are consumed per ton of finished

TABLE III-2 - INDICATORS OF EDUCATIONAL ATTAINMENT AND INDUSTRIAL DEVELOPMENT:

AVERAGES FOR INDUSTRIALIZED COUNTRIES AND DATA
FOR SELECTED DEVELOPING COUNTRIES WHICH PRODUCE STEEL

	% Population 5-19 Years in Primary and Secondary Levels of Education (1960)	% of Illiterate Population 15 Years and Over	Enrollment at Higher Level of Education Per 100,000 Total Population (1960)	% of Higher Education in Science and Technology	Engineers, Scientists Per 10,000 Population	Expenditure on Education Per cent of National Income	% of Male Economically Active Population in Manufacturing	Percentage of Manufacturing in Gross National Product
Approximate Averages for ECSC, USA, USSR and JAPAN	72	4.5	906	29	42.2	4.8	28.7	32.5
LATIN AMERICA:								
ARGENTINA	57	14	827	14.9	12.5	2.5	19.8	21.3
BRAZIL	38	51	132	18.6	na	2.6	9.5	na
CHILE	58	20	257	17.2	na	2.4	16.9	20.1
COLOMBIA	37	38	296	32.7	na	2.1	9.9	17.0
MEXICO	42	35	258	18.3	na	1.4	na	13.2
PERU	39	na	253	31.3	na	2.9	na	na
VENEZUELA	51	48	355	21.9	na	4.1	8.8	11.1
AFRICA:								
ALGERIA	25	88	70	na	na	na	5.6	10.7
MOROCCO	21	na	40	na	na	na	6.2	14.1
MIDDLE EAST:								
EGYPT	34	80	399	na	na	na	9.6	13.7
IRAN	na	na	na	16.3	na	na	na	na
ISRAEL	69	6	700	42.3	na	3.0	26.4	na
LEBANON	53	na	345	26.1	na	2.1	na	na
FAR EAST:								
INDIA	29	81	220	27.3	2.4	1.7	9.5	na
PAKISTAN	20	81	165	29.9	na	1.2	6.2	12.5
SOUTH KOREA	na	na	na	30.3	na	4.1	na	na
TAIWAN	59	46	329	39.6	30.0	3.3	12.3	18.3

Source: United Nations Centre for Industrial Development, The Question of Human Resources in Industrial Growth, (Seminar on Social Aspects of Industrialisation), Minsk, Byelorussian Soviet Socialist Republic, 11-25 August 1964, Working Paper No. 7, Agenda Item No. II(a), Annex A, pp.4-8; Annex C, pp.1-4.

These factors, as well as the other indicators listed, offer some explanation of the lag in labor efficiency in the developing nations. As a result of this lag, the work force needed adequately to staff a steel plant in a developing country is usually larger than that required for an identical plant located in a highly industrialized nation.

Where the supply of skilled labor is limited, the country planning a steel operation must evaluate its labor resources to determine training requirements for workers, technicians and engineers. In a developing country it is frequently the case that the wherewithal to gain first-hand experience in steel plant operation does not exist, and so key personnel must be sent to countries with developed steel industries for training on production units similar to those planned for the proposed steel installation. Assuming that theoretical university training has already been provided, it is customary for engineers and technicians to be given two or more years of practical training abroad. In the case of operating personnel, the survey made of the proposed Bokaro Steel Mill in India pointed out that it is usually a matter of three to four years before a foreman or apprentice is properly trained for his job.

Construction schedules for the plant should be set so that personnel training can be largely completed prior to the final installation of equipment. This will allow the trainees to observe the plant's completion and participate in its start-up. During the initial phases of its operation and for several years afterward, management personnel, technicians and skilled labor are usually brought in to assist in operating the new plant and to provide additional training for local workers. Therefore, in its plans for a new steel operation, the developing country must take into account the cost of training local personnel to man the plant, as well as the cost of any management contract that

steel products. It was revealed that flat rolled products were in shortest supply. A survey of steel consumers indicated that the deficiency in flat product supply for 1955 was 17 per cent. Spot checks of key industries made in 1957 indicated that the deficiency in this product category was increasing.

During the years 1953-1955, consumption of flat products averaged 39.1 per cent of finished steel consumption. In addition, the flat products share of imports was higher than that for domestic production indicating a higher demand for flats than for other kinds of products. Flat product imports accounted for 48.8 per cent of total finished steel imports, whereas the domestic output of flat products constituted 34.8 per cent of total domestic production. It was also noted that the ratio of flat products to total production was rising in other nations, as for example in Western Europe, where flat product consumption had increased from 36 per cent of the total in 1951 to 44 per cent in 1954-1955.

It was estimated that by 1960 the demand for flat products in Brazil would constitute 40 to 45 per cent of finished steel demand. It was estimated that ingot steel demand by 1960 would be 58 per cent above 1955 consumption, and that by 1965 ingot demand would be 121 per cent greater than 1955 apparent consumption. These demand estimates were then applied to finished steel products with the following results:

	Thousands of Metric Tons		
Production Plus Imports	1955 Actual	1960 Estimate	1965 Estimate
Ingots	1,582	2,500	3,500
Finished Steel	1,318	2,080	2,900
Flat Products	544	-	-
at 40% of Total		832	1,160
at 45% of Total		936	1,305

Based on the above breakdown, flat product demand for 1960 was estimated at 800-900 thousand tons and for 1965 at 1200-1300 thousand tons. It was maintained that the outlook for domestic motor vehicle production supported these estimates, and in fact, made the upper range of the estimate more realistic than the lower range. It was noted that 13,600 trucks and busses were manufactured in Brazil in 1956, but only 50 per cent of the parts used were produced domestically. Government authorities had stated that by 1960 local assemblers had to increase the percentage of domestically made parts to 90 per cent of truck weight and 95 per cent of passenger car weight, or face increased foreign exchange costs. The Government approved production goal for 1960 was set at 225,650 vehicles. Given this situation, the supply-demand future for flat products was estimated as follows:

Flat Products
Thousands of Metric Tons

Production	1955	1960	1962	1965
Companhia Siderurgica Nacional	348.8	515.0	515.0	515.0
Belgo Mineira	33.4	60.0	70.0	80.0
Acesita	10.2	37.0	37.0	55.0
Total	392.4	612.0	622.0	650.0
Demand	-	900.0	1060.0	1300.0
Deficit	-	288.0	438.0	650.0

A deficit was foreseen owing to the time requirement for the construction of a steel mill. No production was foreseen from Cosipa until 1962, and by that time it was estimated that the deficit in flat product supply would be over 400,000 tons. This meant that Cosipa's initial production of 300,000 tons of

flat products per year would find a ready market. Further, even after the planned second-stage expansion to 500,000 tons per year, a deficit was foreseen for 1965.

Once the general magnitude of flat product demand was estimated, the individual product breakdown was next assessed. Here the consumption pattern of 1953-1955 was used as a base, although admittedly consumption did not reflect true needs. The demand-supply situation for individual products was estimated as follows:

Product	% Product to Flat Products Total 1953-1955	Est. 1962 Demand	Est. 1962 Production	Est. 1962 Shortage	Cosipa's Proposed Initial Production
Plate	18.8%	200	102	- 98	45
Hot rolled sheet	22.9	240	138	-102	100
Cold rolled sheet	27.2	290	108	-182	110
Galvanized sheet	2.6	30	24	- 06	20
Tin plate	23.5	250	180	- 70	25*
Welded pipe stock	5.0	50	70	+ 20	-
Total	100.0%	1060	622	-438	300

* Tin mill black plate

In addition to the size and type of markets, their location was also studied. The geographical consumption of rolled steel exclusive of light structural and wire products was as follows:

Consumption Pattern of Rolled Steel

	% of Total Consumption
North (from Amazonas to Espirito Santo)	7.1%
State of Minas Gerais and Central States	5.7
State of Rio de Janeiro (excluding suburbs of the Federal District)	6.8
Federal District (including part of the State of Rio)	27.1
State of Sao Paulo	45.5
South (Parana to Rio Jrande do Sul)	7.8
Total	100.0%

The state of Sao Paulo accounted for almost half of the total consumption of rolled steel and when combined with Rio de Janeiro, the Federal District and the South, 87 per cent of the steel market was represented. Brazil's automobile industry was centered in Sao Paulo and, consequently, Cosipa's plant site at nearby Piacaguera was located in the major steel consuming area. Thus it offered the advantage of low shipping costs on finished products and quick customer service.

Construction Plan

The Cosipa steelworks was projected in three stages as follows: Stage I - 300,000 tons per year, Stage II - 500,000 tons per year, Stage III - 1,000,000 tons per year. Correlation of these intended tonnages with the findings of the market analysis indicated that the proposed output was well within the expected market requirements. The facilities planned did not duplicate existing steelworks and thus complemented existing sources of rolled steel supply.

Although it was recognized that some of the major producing units were not particularly well suited to a total production of 300,000 tons per year, as planned for Stage I, nevertheless, it was decided that this level of output was a logical starting point. This decision was made in view of the difficulties associated with a project based on a large production program and in consideration of the urgent need to avoid an unduly high initial capital requirements figure. It was concluded that the 500,000 tons of finished product per year planned for Stage II could be readily attained by an easy expansion from Stage I and that this would improve the plant's profit potential significantly.

The product mix proposed for Stage I was entirely in flat rolled steel and primarily in hot and cold rolled coils and sheet. This output was to be supplemented by smaller tonnages of plates and galvanized steel products, as already noted. It was expected that the 500,000 tons of finished product in Stage II would be readily absorbed into the product mix for Stage I. For Stage III, another analysis of the market situation was planned and expansion schedules were to be adapted accordingly.

In most of the major producing departments, the plant design for the production of 300,000 tons of finished product per year was readily adaptable to the 500,000 ton Stage II level of output. The most significant exception was in the blast furnace department. The blast furnace that was adequate for Stage I was not at all suited to Stage II. The following comparison pointed this out:

	Stage I	Stage II
Pig iron required - tons per year	354,400	597,200
Pig iron required - tons per day	1,010	1,710
Hearth diameter of the blast furnace for the required capacity	22' - 6"	28' - 0"

As a result of the blast furnace requirement for expansion in Stage II, a blast furnace with a 28 ft. 0 in. diameter hearth was chosen for Stage I. Plans called for the operation of this furnace at 80 per cent of capacity, and coke ovens, as well as sintering facilities, were to be constructed only as required for the furnace burden at this rating.

Plant Location

A major section of the study was devoted to a determination of the best plant location with emphasis on the costs of assembling raw material and of shipping finished products. A comparison was made of four sites upon which identical steel mills of 285,000 tons were hypothetically located, and the minimum freight transportation needed at each of these sites was examined. The four sites were as follows:

1) Santos which was located in the principal market area 485 sea miles from Vitoria and 300 sea miles from Imbituba.
2) Vitoria which was on the shipping harbor for Itabira ore 286 miles from the ore mines and 735 sea miles from Imbituba.
3) Ana Matos located at the ore mines.
4) Imbituba which was on the shipping harbor for Santa Catarina coal 50 miles from the coal fields.

Required ton kilometers of freight transportation were used to rank the four sites and it was assumed that empty ore cars returning from Vitoria to Itabira

would bring coal to Ana Matos at half of the tariff in force. It was also assumed that each of the hypothetical plants used 30 per cent national and 70 per cent imported coal. The alternative sites were ranked as follows, from the lowest overall freight cost to the highest: Santos, Ana Matos, Vitoria, Imbituba.

The area chosen by Cosipa was located at Piacaguera situated at the foot of a mountain range which separates the Santos flatlands from the Sao Paulo plateau. It is bordered on the south side by a sound of Santos Bay. It is on the main line of a broad gauge railroad, Estrada de Ferro Santos a Jundiai, 19 kilometers from Santos and 60 kilometers from Sao Paulo. The site had the following advantages:

1. It was located on a developed harbor with docks, moorings and other required facilities.
2. The broad gauge railroad serving the plant site connected it with the harbor as well as to Sao Paulo, the major steel consuming area. Interconnecting railroads afforded access to areas throughout the country.
3. A narrow gauge railroad was operating at Santos, and if necessary it could be extended to the steel plant.
4. There was a modern, four-lane concrete highway extending to Sao Paulo and to the entire road system of southern Brazil. By using this highway and the southern roadways, Cosipa, located at Piacaguera, could easily reach 87 per cent of the existing Brazilian steel market and in the future supply steel to Argentina, Uruguay, Paraguay and Bolivia.

years, and steel production, which is an immediate reflection of capacity, increased from 31 million tons to 70 million tons for the Western European countries. A similar growth took place in the East European nations as production there increased from 19 million tons in 1946 to 50 million tons in 1952. Exclusive of the United States and Canada, where over the same period production increased from 69 million tons to 97 million tons, there was virtually no growth in the rest of the world. Thus the rebuilding stage had been accomplished by 1952 and from that time forward the economies of the industrialized steel-producing countries began to expand. This was the result of an increase in demand at home and also a desire to build up export markets for iron and steel.

Between 1952 and 1963 world steel production grew from 233 million tons to 422 million tons. Much of this increase took place in the industrialized countries. For example: in Western Europe output grew from 70 million tons to 120 million tons. In the Eastern countries it expanded from 50 million tons to 116 million tons and in Japan production increased from 9 million to 35 million tons. Thus these three areas accounted for 161 million tons out of a total increase of 189 million tons. The remarkable increase in the Socialist countries was consumed primarily within that area while some of the increase in production of other countries, exclusive of the United States, found markets in other parts of the world. Thus, the industrialized countries strove first to rebuild and then to expand in order to meet their own needs and develop a growing foreign trade.

Between 1952 and 1963 there was considerable steel building activity, as has been indicated statistically in Section I, among the developing nations of the world. True the results were small by comparison with those of the industrialized countries. However, they represented a considerable

5. Within less than an hour from Piacaguera, nine automobile plants were being built to take advantage of the above noted transportation facilities.
6. The Cubatao 1,000,000 horsepower electric plant was located 5 miles from Piacaguera and an 88 Kv transmission line under construction was to pass at less than half a mile north of the plant site.
7. An ample water supply existed, including 150 cubic meters per second from the hydroelectric power plant discharge.
8. Within five miles of the plant site there was an oil refinery and all related petrochemical industries including fertilizers, carbon black, estirene and formol.
9. The possibility existed for selling all of the by-products from the steel operation.
10. In the immediate area there existed good foundries, mechanical and electrical shops, refractory plants, cement plants, suppliers of building materials, contractors, skilled and unskilled labor and training schools for industry.
11. Enough housing, schools, hospitals, banking facilities, public utilities and good living conditions were available near the plant site chosen.

Raw Materials

At the time Cosipa was under consideration there were well established sources of iron ore of superior quality and sufficient quantity to support a large steel industry in Brazil. Then current mining operations offered a choice of selected lump ore, a run-of-mine mixture of lump ore and fines, or all fine ore. It was decided to utilize the run-of-mine ore which could be obtained at a medium price, and to sinter the fine portion of the ore. The following chemical and screen analysis of Hematita run-of-mine ore indicated that the Cosipa steel plant would have a satisfactory ore supply.

Hematita "Run of Mine"

Sieve Size	% in Weight	% Ferro	% Phos.
Between 8 in. and 1-1/2 in.	37.06	69.48	0.0134
+ 1-1/4 in.	6.94	68.95	0.0188
+ 1/2 in.	12.80	68.15	0.0242
+ 3/8 in.	8.28	68.68	0.0310
Under 8/8 in.	34.58	64.01	0.0512
	Average	67.2%	0.0297%

Local coal reserves had a high ash and sulphur content and thus had to be washed before being used as coking coal. Available supplies of this washed coal were sufficient for Cosipa's program. It was learned from experience that 30 per cent of washed local coal and 70 per cent of imported coal from the United States was a satisfactory mixture for the production of blast furnace coke. This mixture was to be employed at Cosipa.

The Sao Paulo area contained limestone deposits suitable for use in the blast furnace charges and as fluxes, so that limestone could be secured without difficulty. Dolomite, some refractories and other minor items were also available in Brasil. The total quantities of raw materials needed per year in Stage I are listed below:

Major Raw Materials Required - Stage I - Tons per Year

Iron ore - total for blast furnace including sinter	660,000
Iron ore for steel making	12,700
Iron ore - total	672,000
Coking coal - Brasilian	144,000
Coking coal - imported	338,000
Coking coal - total	482,000
Limestone - for blast furnace	153,000
Limestone - for steel making	48,000
Limestone - total	201,000
Dolomite - for steel making	4,500

Estimated Production Costs

To estimate the costs of production of salable products from the proposed plant, the prices of the raw materials delivered at the plant site were combined with the operating costs of the various departments involved in preparation of the final steel products. Operating costs and prices were estimated on the basis of data prevailing in the first quarter of 1958 The operating costs used were those achieved by competent management using good practices on modern facilities similar to those proposed for Cosipa, under general conditions similar to those experienced by other Brazilian steel producers. They were developed on the basis of a fully integrated plant. Raw material costs were based on quotations and estimates which were related to a relatively small scale operation and transportation movement, and it was expected that as operations expanded such costs would approach a generally lower level.

The production costs estimated for Cosipa are listed in the table below. Plans called for ingot purchases from an outside source during the first and second years of operation. In the second year purchased ingots were to be supplemented by some domestically produced ingots. The table includes the estimated costs of finished and semi-finished products using domestic ingots and purchased ingots.

Summary of Estimated Product Costs

(Ingots to Finished Products)

Basis: Self Produced Ingots at 5054 Cr/Ton
Purchased Ingots at 7300 Cr/Ton

	Estimated Costs (Cruseiros per Ton of Product)	
	Made from Own Ingots	Made from Purchased Ingots
Slabs	5,554	8,092
Heavy Plates (Not Finished)	5,880	8,494
Heavy Plates (Finished)	7,115	10,278
Hot Rolled Coils (Mill Finish)	6,662	9,341
Hot Rolled Sheets	6,959	9,772
Hot Rolled Coils (Pickled and Oiled)	7,025	9,751
Hot Rolled Sheets (Pickled and Oiled)	7,375	10,216
Cold Rolled Coils	8,069	10,802
Cold Rolled Sheets	8,650	11,520
Tin Mill Black Plate Coils	9,537	12,270
Tin Mill Black Plate Sheets	10,204	13,047
Galvanized Sheets - Plain	11,947	14,846
Galvanized Sheets - Corrugated	12,195	15,094

Estimated Costs of Plant

The investment costs of steel mill facilities and equipment are difficult to cite and are often so high so as to be prohibitive. This particular plant which was designed to have a finished product capacity of 300,000 metric tons after the completion of its first stage had a total cost of equipment and construction of about $170 million U.S.A. dollars before any allowance for increasing costs was made. The major components of this total cost are as follows:

Material Handling	$ 3,675,000
Sinter Plant	2,417,000
Coke Plant	8,900,000
Power Station and Distribution	9,570,000
Blast Furnace Plant	7,581,000
Oxygen Bessemer Plant	6,767,000
Rolling Mill Plant	43,406,000
General Facilities	8,092,000
Total	$90,408,000

In addition to the above facility costs, labor costs of $29,390,000 and $35,937,000 in material costs also had to be met. Further costs included $4.7 million for spare parts, $8.6 million in freight costs and other costs amounting to about $10 million. Thus, the total cost with no contingencies was near $170 million. Allowing for increases in unit costs and other costs, the total cost was about $191,000,000 which was the equivalent of about $660 per ton of finished output. This cost of plant facilities and construction

expressed in terms of cost per unit of output is significant in that it is a reflection of the tremendous amount of capital needed to build a fully integrated steel mill. This cost, and the resultant debt burden often prevents a prospective steel firm from building a larger and more economical plant at the outset. However, as additional facilities are put in place, the investment and construction cost per ton of output will tend to decline.

The analysis of the cost of building a steel mill, even a relatively small one, points to the importance of two factors: first, the availability of the necessary funds, and secondly, the need for a relatively stable source of sales revenues in order to meet debt obligations. This latter factor is closely associated with the size and structure of the market which the plant will serve.

Case Study II: National Steel of Pakistan Limited, Karachi, Pakistan

A program for establishing a steel plant in West Pakistan involved a study of the same general considerations as were essential to the steel project in Brazil, namely, the potential steel market in the area and the products to be made for that market, the availability and quality of the areas' raw material resources, selection of a suitable plant site, the manufacturing processes to be used, the capital and construction costs involved in the project and production cost estimates.

Market Survey

Geographically, Pakistan is divided into two provinces, East Pakistan and West Pakistan, which are separated by about 1,000 miles of Indian territory. The proposed steel mill at Karachi would be in West Pakistan so that in estimating the future demand for steel, the market in East Pakistan was not considered. A steel plant was being built in the eastern province to provide for a significant percentage of local requirements, and the cost of shipping steel between the two provinces would make it difficult to compete with steel imports to East Pakistan, particularly those from Japan.

Imports provide almost all of West Pakistan's supply of semi-finished and finished steel products with the exception of a small amount of domestic production from scrap.[1] As a result, import data were considered the best available measure of the size of the steel market, although their usefulness in this regard was affected by the limitations which the government placed on

1) Steel is produced in several small electric furnace plants, but tonnage output had been declining due to a shortage of scrap. Ingot production in West Pakistan in 1962 was 6554 metric tons compared with 11,695 tons in 1957.

imports due to shortages of foreign exchange. This placed a ceiling on effective steel demand, so that import tonnages did not depict its true growth. After 1959, the increased availability of foreign exchange due largely to United States aid made it possible to ease import restrictions. Nevertheless, from a survey of steel consumers undertaken in conjunction with the market study, it was estimated that a demand-supply imbalance of 25 per cent still existed in 1963. Despite its shortcomings, however, import data reflected a trend of increased consumption and indicated which steel products were most in demand.

Import consumption for the years 1957-1962 was as follows:

Year	Imported Steel Consumption (thousands of metric tons)	Per Capita Consumption (pounds)
1957	224.1	12.7
1958	222.0	12.3
1959	196.3	10.7
1960	320.7	17.1
1961	346.4	18.1
1962	343.7	17.5

With respect to the 343.7 thousand metric tons of imports in 1962, the major product categories were:

Product	Tons (thou.)	%Total	Product	Tons (thou.)	%Total
Billets	171.4	49.9	Structurals	16.9	4.9
Rails	29.8	8.7	Pipe, Tube	16.0	4.6
Galvanized Sheets	20.4	5.9	Tinplate	15.9	4.6
Uncoated Sheets	18.5	5.4	Plates	14.3	4.2

Half of West Pakistan's steel imports were in billets for rerolling into finished steel products. In 1961 there were about 100 rerolling companies and a total of 132 rolling mills in the province. The billets used ranged in size from 2x2 to 6x6 inches, with more than half in the 2 inch size, and were rolled into reinforcing bars, light structural sections, baling hoops and wire. The rerolling companies were estimated to have an efficient capacity in 1963 of about 260,000 metric tons of which upwards of 75 per cent was concentrated in the reinforcing bar category. Light sections accounted for 10 to 15 per cent of capacity, with 5 per cent in baling hoops and 4 per cent in wire products.

The distribution of steel imports in West Pakistan during 1962 by major market classification is listed on the following page. The rerollers accounted for almost half of total steel imports and that the other principal consumers were the railways, containers and non-railway construction. Taken together these four market sectors accounted for 73.4 per cent of total steel imports.

Distribution of Steel Imports in West Pakistan During 1962 by Market Classification

Market Classification	Total Metric Tons
Rerollers	170,736
Wire Products	4,513
Galvanized Pipe	9,695
Reinforced Concrete Pipe	1,875
Water and Power Development Authority	8,953
Other Construction, Except Railway	15,345
Railway - Excluding Rerolling Mill	46,896
Shipbuilding and Repairing	3,198
Containers	19,437
Industrial Machinery and Equipment	2,291

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tonnage in absolute terms; almost 25 million, with the bulk coming from Latin America, India and China

Objectives Motivating Steel Investment in Developing Countries

The objectives in the developing countries not only differ from those of the industrialized countries but, also, among themselves. The desire to develop a steel industry is motivated by a number of reasons. These will vary from country to country depending on the degree of economic development that has been attained, as well as the priorities that have been assigned for future growth and development. The most prominent reasons would seem to be:

1. The desire for a nation which has attained political independence to match this with some degree of economic independence. This almost always finds expression in the construction or plans to construct some type of steelmaking operation, for steel is so fundamental to the economy of any nation that no independent country wants to feel that it is entirely dependent on the outside world for this basic commodity.

2. The second reason is intimately tied with the first, for these countries have felt that if they can develop a steel industry of their own--no matter how small--this will help improve their world trade and foreign exchange position.

3. There is the desire to build steel-consuming industries which will furnish much needed consumer durable goods. A prime example of the successful accomplishment of this objective is Mexico.

4. Many of the developing countries have been endowed by nature with extensive supplies of raw materials necessary for steelmaking, particularly, iron ore. Before World War II, and much more so in the years after, they were considered a source of raw material supply for the industrialized countries. Because of the economics of the situation, there has been a great

Projected Steel Demand

Reliable information on the possible future growth of the steel consuming industries was not readily available, and so it was necessary to adopt the broader approach of relating future steel consumption to anticipated large-scale manufacturing output. The following table give a projection of steel demand for 1965 and 1970.

Two Projections of Steel Demand in West Pakistan[1)]
(thousands of gross tons)

PROJECTION I:

Product Category	Actual 1960-1961	1965	1970
Billets	120	250	375
Rails	30	30	50
Medium Sections	43	66	100
Hoop and Strip	28	48	72
Plain Sheet and Plate	52	82	120
Galvanized Sheet	8	15	30
Tinned Sheet	20	35	60
TOTAL	301	526	807

PROJECTION II:

Product Category	Actual 1960-1961	1965	1970
Billets	164	219	350
Bars and Rods	9	12	20
Wire and Wire Rods	13	17	29
Structurals	16	22	30
Rails	25	21	25
Track Accessories	7	25	25
Wheels, Tyres and Axles	2	7	10
Plates	22	30	50
Uncoated Sheets	25	32	64
Galvanized Sheets	18	26	51
Tin Plate	16	25	42
Pipe, Tubes and Fittings	22	29	49
Strip	12	16	27
Miscellaneous	1	3	6
TOTAL	350	480	796

1) The projections above were made roughly two years apart. Data are in thousands of gross tons.

The planned production of finished steel products from the proposed steel plant at National Steel of Pakistan Limited was 375,000 tons, or approximately 47 percent of the steel demand that was projected for 1970. The processes and facilities to be installed were selected with the intention that the company be able to produce many of the product categories that were in demand. The table on the following page lists the projected steel requirements for 1970 and the company's participation in the market. The plant layout, processes and facilities selected provided for an ultimate expansion of crude steel capacity to about 2 million tons. A description of NSPL's plant is provided in the facilities section of this manual as a profile of a semi-integrated steel operation.

Plant Location

A number of sites of sufficent acreage for NSPL's plant were available in the Karachi area, and five sites were selected for consideration. They were as follows:

1) Mawupur on the west side of the Layari River. This site has an area of 700 acres bordering on the north side of the harbor and as much as 1200 to 1500 adjoining acres which could be utilized if necessary. The 700 acre tract could accommodate the expansion of NSPL's capacity to 2 million tons of ingots annually.

2) Kiamari located on low ground east of the southern end of the East Warf. This site was available only on a rental basis and with an area of 1000 acres, a rental rate of 3 rupees per square yard per year would amount to an expense of $3 million annually.

3) Pipri located on Gharo Creek about 28 miles east of Karachi. By water the available land was 20 miles inland and its use would necessitate

channel construction and maintenance in order to make the site accessable to the degree required for steel manufacture. The site had a number of advantages, the most significant of which was its close proximity to a government housing development at Landhi where about 300 to 400 thousand people live, many of whom were in need of employment.

4) Buleji located along the seacoast 16 miles west of Karachi. This site offered the advantage of adequate land at low cost.

5) Sonmiani, located on Sonmiani Bay which is 52 miles northeast of Karachi.

The Maripur site was assessed to be the most suitable for the proposed steel plant. The acreage available is adequate and the site is accessable to rail and highway transportation. The site can also be provided with deep water access by means of a channel 2.7 miles long. Water is obtainable from the water system at Karachi, although this would require construction of a new main for which capital costs were not estimated in the study. Additional costs, also unestimated in the study, would have to be incurred in bringing electric power to the plant site. An electric power line of 132 kv and six miles in length would have to be constructed.[1]

The Kismari site was discarded due chiefly to the annual rental which would be incurred. The Pipri site was abandoned because the costs of channel construction would not be economically feasible in connection with the steel operation that was planned. The Buleji site was turned down because of a complete lack of harbor facilities, and the Sonmiani site was evaluated as unacceptable because its development would be a five-year project.

1) Although additional costs for external services and utilities were not estimated in the economic survey made by the technical advisers, Pakistan sources had made the following estimates: Electric power line and main substation $3 million, railroad $800,000, water mains $500,000.

Raw Materials

Because of the shortage of foreign exchange in West Pakistan and the consequent need to limit imports, it was preferred that the new steel plant utilize domestic supplies of iron ore, coal and limestone, the basic raw materials for steel production. Programs of exploration and testing were undertaken as early as 1947 to find suitable and adequate sources of iron ore and coal, but these efforts proved unsuccessful. Although iron ore reserves in West Pakistan total 400 million tons and coal reserves 350 million tons, the deposits are for the most part hard to reach and of low quality. Adequate supplies of good quality limestone were found and are easily accessable. Dolomite and fluorspar are also available within reasonable distance from the plant site, and large quantities of natural gas are also available.

Of the iron ore deposits that were found, only a few are suited for direct use in the production of steel. These are located at Chitral in the far northern section of West Pakistan near the West Pakistan-Afghanistan border, and at Chagai in the western section of the country also near the Pakistan-Afghanistan border. However, access to these deposits is difficult and the reserves too small, totaling 4 to 6 million tons at Chitral and only 200,000 tons at Chagai. The largest deposits are located in the Kalabagh region south of Chitral and totaled about 293 million tons. However, they are complex mixtures of iron and silica and are not suited to commercial exploitation. The silicon content of the iron ranges from 13 to 25 per cent.

All of the coals in West Pakistan which are available in quantity are low in fixed carbon and high in sulfur, with sulfur content ranging from 2 to 6 per cent. In general, the coals as mined are very powdery and friable and show no appreciable coking properties. Consequently, the coals were not regarded as useful for steelmaking.

Since local reserves of iron ore and coal are not suited to steel production, and since adequate supplies of steel scrap are not available from local sources, it was concluded that the proposed steel plant would have to depend on imported sources of these major raw materials. It should be noted that coal, coke and iron ore were not required in NSPL's initial operating stages, so that scrap imports which would be needed to operate the plant's electric furnaces were of immediate concern. It was concluded that the United States, which accounted for 70 per cent of the world export market for scrap, would probably be the principal source of NSPL's scrap requirements.

Estimated Costs of Plant

The total estimated cost of the production facilities planned for the NSPL plant at Karachi was $118.4 million. This total was based on prices and exchange rates as of August 1963.[1] Approximately $32.7 million was to be furnished by Pakistani sources, with $85.7 million obtained from sources in the United States. As already noted, the plant was to have a finished product capacity of 375,000 metric tons.

Since August of 1963, the plans for the plant have been expanded to allow for an ingot production of 575,000 tons and consequently the cost has increased to about 200 million dollars.

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1) An exchange rate of 4.76 rupees per U.S. dollar was used.

Although the developing countries have a number of problem in common in the establishment of a steel industry, they also have those that are peculiar to each country. Thus it will be necessary to consider the developing countries individually in order to determine the goals and the possibility of their achievement.

For this purpose they are divided into four major groups: Latin America, Africa, the Near and Middle East and the Far East. In treating these areas the present status of the countries involved will be outline with respect to the current steel facilities, raw material availability and the general economic infrastructure. The steel output will be given in terms of total tonnage and individual products.

An analysis will be made of the relationship between the developing countries and the industrialized steel producers. This will include trade in steel products, steel mill equipment, iron ore and coal. Obviously this is a two-way operation since the industrialized countries are in great part dependent on outside sources for raw materials.

Subsequent to this the goals which have been established by the developing countries will be assessed in terms of feasibility of their achievement. Here such problems as availability of capital and technical and skill personnel and the state of the infrastructure of the economy will be analyzed.

In addition, the raw material picture will be presented and, finally, an evaluation will be made of the projected facilities which are to be installed to achieve the goals which are contemplated for installation in the countries under study.

Latin America

In 1963 steel production in Latin America reached a new high of 6.9 million metric tons. This was an increase of 19 per cent over 1962 when 5.8 million tons were produced. The output figure in 1963 had great significance for it enabled Latin America to care for more of its own steel needs than ever before. Up until 1963 there was a constant widening of the gap between steel consumption and steel output. In 1950 the area consumed 3.8 million metric tons more than it produced. In 1962 this had grown to 4.2 million metric tons. However, the growth and production in 1963 cut this figure to approximately 3 million metric tons.

Nine steel-producing nations contributed to this result including Argentina, Brazil, Chile, Colombia, Cuba, Mexico, Peru, Uruguay and Venezuela. This represented a remarkable growth over 1950 when two countries, Brazil and Mexico, produced approximately 153,000 metric tons of steel and over 1950 when four countries in the area, Argentina, Brazil, Chile and Mexico, produced 1.4 million metric tons.[1]

The following table gives figures on output, apparent consumption and excess of consumption over production for selected years.

1) There may have been a small volume of production in non-integrated plants in Colombia and Cuba, but production data are not available.

Table III-3

Steel Production and Apparent Steel Consumption of the Latin American Steel Producing Countries, 1930-1963
(thousands of metric tons)

Year	Crude Steel Output	Apparent Consumption	Excess of Consumption over Production
1930	152.6	2180.4	2027.8
1950	1425.0	3502.2	2077.2
1960	4749.8	8556.1	3806.3
1961	5304.9	9356.5	4051.6
1962	5826.3	9987.0	4160.7
1963	6937.4	10000.0*	3000.0*

*approximate data.

Source: Foreign trade reports of the Latin American governments and reports of the Latin American Iron and Steel Institute, ILAFA.

A number of reasons can be offered for the fact that a rapidly increasing output did not keep pace with consumption. Part of the explanation stems from the fact that steel production is a means of fostering economic development. Domestic steel production, of itself, can and often does result in an expansion of steel requirements because of the impetus which it gives the steel consuming industries.

Further, although production was on the increase, there were a number of limiting factors which prevented it from growing faster. First, and perhaps the most significant, was the lack of capital which is required in large amounts for the installation of steel capacity. Second, was a lack of trained personnel. Third is the very nature of steel demand in some of the smaller countries, for although they have adequate resources in terms of raw materials, the internal market is not sufficiently developed to support a steel plant of the scale needed to achieve economic results in respect to investment and operating costs.

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desire on the part of these countries within the last few years to exploit their own raw materials and turn them into finished steel products.

5. A fifth reason which is by no means insignificant is the desire to create industrial employment and raise the standard of living.

Political and Economic Independence

The desire for steel facilities in a newly independent country is fundamentally based on economic considerations. However, the desire is often tempered by non-economic factors. This is by no means unusual, nor is it confined to new developing countries, for in a complex society very few decisions can be made which are purely economic. Social and political factors have a great influence on the decision. However, in spite of the effect that politics and social conditions have on economics, the decision hopefully should be basically sound. Thus if the economics of the situation do not warrant a decision, it would seem that it should not be made despite the political and social implications involved.

Foreign Exchange Positions

Many developing countries which must import steel and export raw materials have found in the past few years that their foreign exchange positions have deteriorated. For example, a number of the Latin-American countries exporting raw materials, including substantial quantities of rich iron ore, find that the prices of imported finished steel products have tended to rise and, as a consequence, it is difficult to maintain an equitable position in foreign exchange. Therefore, there is a great and understandable desire on the part of these countries to become manufacturers and, if possible, exporters of steel. The Latin-American countries produced almost 7 million tons of steel in 1963 and plan to increase their output to 18 or 20 million tons by

1972. This increase, if achieved, would allow the Latin-American countries to take care of their own steel requirements and have a surplus for exports. Such a situation is deemed desirable in order to better their position in world trade by providing an added source of foreign exchange.

The improvement of foreign exchange positions through steel production cannot be accomplished quickly and thus must be viewed as a long-range objective. This is so for a number of reasons. The initial output from a steel installation is likely to be high cost and the prices needed to break even must also be high in relation to the prices of imported steel. This is particularly true in many of the developing countries where a lack of skilled labor and deficiencies in certain other resources serve to prolong the break-in period required to bring the operation to its peak efficiency.

In the absence of government subsidies to the new industry, or controls stipulating purchase of the domestic product or restriction of imports, the high prices of this initial domestic output limit the extent to which it displaces steel imports. In instances where the domestic steel output is priced to compare favorably with imported products or is granted high protection, steel imports are to a limited extent displaced. The reason for this is that the installations are necessarily limited to the production of a few products, while the needs of the country usually range through the entire classification of steel products. For example: a country just entering the steel business may erect an electric furnace and a small bar mill while its needs include plates, sheets, iron, tin plate and a number of other products. Thus it will be able to restrict or eliminate its imports of bars, but must continue to import the other products.

The extent to which the displacement of steel imports in developing countries may improve the country's foreign exchange position is indeed limited for it cannot be assumed that import requirements will level off once domestic

production is started. In fact, the stimulus to steel-consuming industries and to the economic system in general, of an investment as sizeable as that required for a steel plant by itself may serve to increase steel demands and, consequently, import requirements. In addition, where outside sources of capital are used extensively to finance the steel installation, this acts to offset the favorable influence of the displaced import tonnage upon the country's balance of payments and continues to do so until the loan is repaid. Should a price inflation develop domestically, the unfavorable effect of the repayment of sizeable borrowings upon the country's balance of payments is increased. In the long run, once the installation is paid for and efficient rates of operation are attained, trade and foreign exchange positions can be improved significantly, particularly if production in the steel categories produced is in excess of domestic needs and can be exported at prices which are competitive in international markets.

Steel-Consuming Industries

Another principal reason for developing a domestic steel industry is the expectation that durable goods industries, which consume steel, will grow within the economy. On this point there has been a considerable amount of debate. On the other hand it has been maintained that it would be far better for these countries to import steel and build up the consumption industries before a steel industry is actually started. There is unquestionably some merit to this contention, especially since the prices of the imported products would probably be substantially lower than those of domestically produced steel. This would seem to be a far more economic way to function. It has the advantage of building a consuming market to such proportions that the steel mill when installed can be of a greater size and, consequently, take advantage of the economies of scale.

This procedure was followed in some countries in the early 1950's. Notable among those who tried it was India. However, in 1950-1952, world steel capacity was far lower than it is at present and, consequently, it was difficult to obtain steel, in view not only of the low capacity but also of the excessive demand due to generally prosperous conditions throughout the world and a military action which was in progress in Korea.

In the early 1960's with about 400 million net tons of steel produced annually throughout the world and many industrialized countries anxious to find a foreign market for their output, developing countries with little or no steel industry could well consider making long-term contracts for steel at a definite price advantage.

There have been instances in which the development of a steel industry has contributed substantially to the growth of the national economy. This was particularly true in Chile and to a somewhat lesser extent in Brazil. The Chilean Steel Plant was built in 1951 and since that time there has been considerable growth in the nation of steel-consuming industries.

Exploitation of Domestic Raw Material Resources

Many of the developing countries have adequate, and some of them abundant, supplies of iron ore. Those with abundant resources include: India where reserves are extremely high although they have a relatively high aluminum and silicon content; Venezuela where the ore is abundant and rich, although here it tends to be fine; Chile where there is a large supply of ore; Peru, Liberia, Morocco, etc. Unfortunately, most of these countries do not have adequate supplies of coking coal and, therefore, find it difficult to use traditional blast furnace practices for the reduction of iron ore. In a number of instances there are supplies of gas and petroleum and thus direct reduction processes that are substituted in one manner or another for the blast furnace

2 OF 3

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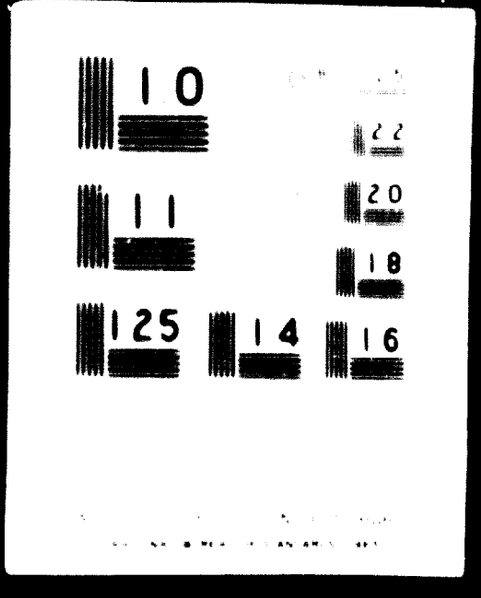

The major steel product groups imported by the Latin American countries in 1982 were sheets of 742,000 tons, heavy and light sections of 501,000 tons, tinplate and coated-flatsheet steel of 387,000, and tubes and fittings of 350,000 tons. The following table breaks down total Latin American steel imports for 1982 by major product groups.

Latin American steel imports by major product groups, 1982
(thousands of metric tons)

Product Categories	Quantity
Tinplate and coated-flatsheet steel	387.0
Railway and track materials	134.0
Heavy and light sections	501.1
Wire rods	97.3
Strip	44.9
Plate	484.3
Sheet	742.4
Tube and Fittings	350.7
Wire	96.8
Tinplate	484.7
Wheels, tyres and axles	80.1

Source: ISSA

Analysis of Latin American Imports by Country

Argentina: In 1962 total steel imports to Argentina totaled 213.2 thousand metric tons. This represented a substantial decline from 1961 when 1.5 million metric tons of steel products were imported. For the same period the production of crude steel in Argentina increased from 696 to 845 thousand metric tons. The major sources of imports in 1962 were West Germany with 295.1 thousand tons, followed by Italy with 125.3, Japan with 125.0, the United Kingdom with 104.1, Belgium with 1[illegible], France with [illegible] and the United States with 96.2 thousand tons. Of Argentina's total of 213.2 thousand tons of imports in 1962, the sheet and plate category accounted for 96[illegible] thousand tons. Other major product groups were ingots, blooms, billets and slabs at 2[illegible].2 thousand tons, bars at 102.1 thousand, tinplate at 9[illegible].1 thousand, and tubes, pipes and fittings at 67.1 thousand tons.

The decline in the import total during 1961-1962 was a outbreak in imports from all of the major countries of origin with two exceptions, Italy and Japan. Imports from Italy increased from 115.[illegible] to 12[illegible].9 thousand tons and from Japan from 91.0 to 125.0 thousand tons. Of the 8[illegible].2 thousand tons of ingots imported, West Germany accounted for 155.1 thousand tons. Italy accounted for 55.3 thousand tons of the 102.1 thousand tons of bar imports, and Japan provided 114.8 thousand tons of sheet and plate imports which totaled 9[illegible] thousand tons. Other major sources of sheet and plate were West Germany 70.6 thousand tons, the United Kingdom 60.2 thousand and France 5[illegible].9 thousand tons.

Bolivia: In 1962, Bolivia imported a total of 16,200 metric tons of steel products. About one-third of this total came from the United States, and about one-half of the total was in flat rolled products.

Brazil: Total imports of steel products were 180.0 thousand metric tons in 1962, the lowest level since 1954 when 175.6 thousand tons were imported. After 1959 when imports reached a peak level of 450.6 thousand tons a steady decline was experienced, while at the same time, crude steel production followed a pattern of steady increase. In 1962, Brazil's output of crude steel was 2.6 million tons. The major sources of imports during 1962 were West Germany with 59.5 thousand tons, Japan with 36.0 thousand, and the United States with 49.1 thousand tons. In 1960 imports from the United States totaled 91.8 thousand tons

The plate and sheet category accounted for the largest share of Brazil's imports in 1962. Imports of this product group totaled 96.8 thousand tons. Although the United States was the major source of sheet and plate during 1961 with about 45 thousand tons of imports, in 1962 half of this total was lost to Japan which became the principal supplier with 29.1 thousand tons. Other import categories were tinplate at 35.2 thousand tons and fabricated structural shapes at 9.9 thousand tons.

British West Indies: Total steel imports in 1962 were 111,500 tons with more than one-half or 60,500 tons supplied by the United Kingdom. The principal products imported were light and heavy sections at 28.2 thousand tons, flat rolled products at 30 thousand tons, and pipes, tubes and fittings at 35.6 thousand tons.

Chile: In 1962 steel imports totaled 87.7 thousand tons, an increase of 8.9 thousand tons over 1961. The principal steel products imported in 1962 were rails and railway track material at 35.0 thousand tons, tubes, pipes and fittings at 29.5 thousand, and billets and bars at 11.4 thousand tons. Rail

imports had increased from 11.7 thousand tons in 1960 owing to an extensive program that was undertaken to improve the nation's railroad system. The trackage was to be renewed using heavier rails to increase load carrying capacity. Between 1961 and 1962 imports from Japan increased from 20.7 to 34.6 thousand tons, whereas imports from the United States declined from 31.1 thousand to 14.9 thousand tons.

Columbia: Steel imports in 1962 totaled about 165 thousand tons, approximately the same as in 1960 and 1961. Plates and sheets, tinplate, and tubes, pipes and fittings were the principal product groups imported. The major sources of imports were Japan at 37 thousand tons, the United States at about 33 thousand, West Germany at 29 thousand, France at 19 thousand, and the United Kingdom at about 13 thousand tons.

Cuba: In 1962 Cuba imported 212.2 thousand tons of steel products. Almost all of this total (200.2 thousand tons) was supplied by the Soviet Union. The principal steel products imported were ingots and semi-finished steel at 100.4 thousand tons, flat rolled products at 71.8 thousand tons, and light and heavy sections at 21.3 thousand tons.

Dominican Republic: A total of 36.4 thousand tons of steel products were imported of which 16 thousand came from Belgium-Luxemburg and 6.6 thousand from the United States. The major tonnages by products were 12.7 thousand tons in sections and 11.3 thousand in flat rolled products.

Ecuador: Steel imports in 1962 totaled 31.5 thousand tons with more than half supplied by Belgium-Luxemburg at about 18 thousand tons. The largest tonnage was in light and heavy sections at 17 thousand tons, followed by flat-rolled products at 8 thousand tons.

Guatemala: The steel import situation in 1962 closely paralleled that in Ecuador. Total imports were 33.2 thousand tons, and Belgium-Luxemburg again accounted for about one-half of the total with shipments of 15 thousand tons. The major product groups were light and heavy sections at 18.3 thousand tons and flat-rolled steel at 9.8 thousand tons.

Haiti: In 1962 imports were 10 thousand tons with 6 thousand coming from Belgium-Luxemburg. Steel sections accounted for about half of the total at about 5 thousand tons, and 2 thousand tons of the total consisted of flat rolled products.

Honduras: In 1962 Honduras imported a total of 13 thousand tons of steel. The major supplier was Belgium-Luxemburg at 5 thousand tons. Steel sections at 5 thousand tons and flat rolled products at 3.1 thousand were the principal product categories imported.

Mexico: Total imports in 1962 were about 125.2 thousand tons, an increase from the 121 thousand tons of steel products imported in 1961, but substantially below the 287.8 thousand tons of imports recorded for 1958. Canada contributed 77.4 thousand tons of the 1962 total, and the United States accounted for 29.9 thousand tons. The United States import total had declined from 107.2 thousand tons recorded in 1960 and 41.2 thousand for 1961. The principal product categories imported during 1962 were rails at 57.5 thousand tons, railway materials at 19.9 thousand, railway axles, tyres and wheels at 12.4 thousand, and bars at 11.7 thousand tons.

Panama: Imports of steel products totaled 21.6 thousand tons with approximately 6 thousand tons coming from Belgium-Luxemburg and the same amount from the United States. Ingots and semi-finished steel made up 4.6 thousand tons and flat rolled products contributed 9.1 thousand tons.

Paraguay: Total steel imports for 1962 were 6.8 thousand tons. Belgium-Luxemburg accounted for 3 thousand tons and the United States for 1.5 thousand tons. Other sources were West Germany and the United Kingdom.

Peru: Peru imported 137.3 thousand tons of steel products in 1962. The principal sources of these imports were as follows: Belgium-Luxemburg 39 thousand tons, Japan 26 thousand, West Germany 23.8 thousand, and the United States 19.5 thousand tons. One-half of the import total, or 68.3 thousand tons, consisted of flat rolled products, and steel sections accounted for 37 thousand tons.

Uruguay: Steel imports in 1962 totaled 77.7 thousand tons, 23 thousand from Belgium-Luxemburg, 13.7 thousand from the United Kingdom and 11.8 thousand from Sweden. The major product categories imported were flat rolled products at 26.7 thousand tons, ingots and semi-finished steel at 21.5 thousand tons and sections at 11.7 thousand tons.

Venezuela: In 1962 steel imports totaled 371 thousand tons. This was above the 1961 level of 301 thousand, but substantially below the 1.3 million tons imported in 1957 and the 677.2 thousand tons recorded in 1958. The major product group was tubes, pipes and fittings with 87.9 thousand tons of imports. This compared with a 1957 tonnage figure of 883.5 thousand tons. Tin plate and sheets were the second largest import category with a tonnage of 64.9 thousand tons. This was above the 1957 figure of 22.7 thousand tons. Imports of angles, shapes and sections were 55.1 thousand tons in 1962, and bar and rod imports totaled 43.9 thousand tons.

Planned Goals for the Latin American Iron and Steel Industry

By 1970 to 1972, if the present plans for the expansion of the Latin American steel industry materialize, the area will have the capacity to produce in excess of 20 million metric tons of steel ingots. The table which follows gives a very detailed listing of projected ingot capacity by country and by plant for the more important steel companies in Latin America. It is followed by a listing of the more immediate expansion plans which have already been announced by the steel companies.

Planned Goals for the Latin American Iron and Steel Industry

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PLANNED EXPANSION OF THE MAJOR INTEGRATED LATIN AMERICAN STEEL PLANTS AND OF THE NATIONAL STEEL INDUSTRY AS A WHOLE

Thousands of metric tons of ingot per year[1]

Country and plant	Thousands of annual tons of ingot							
	1967	1968	1969	1970	1971	1972	1973	1974
Argentina								
Somisa, San Nicolás	1,200	[illegible]	[illegible]	[illegible]	500	[illegible]	2,000	2,000
ACINDAR	55	[illegible]	[illegible]	[illegible]	600	600	600	600
SIDERCA	-	100	100	100	250	250	250	250
SAFTA (Rosario)	-	160	160	160	160	160	160	160
Others[2]	290	298	293	300	311	321	331	342
Total Argentina	1,545	1,918	1,953	2,060	2,171	3,331	3,841	3,952
Brazil								
Volta Redonda	1,150	1,300	1,500	1,500	1,500	1,500	1,500	1,500
Vale do Paraopeba	-	-	-	-	-	2,000	2,000	2,000
Belgo Mineira	600	600	900	900	900	900	900	900
COSIPA	-	-	-	500	500	750	750	1,500
USIMINAS	-	500	750	750	750	750	2,000	2,000
Mannesmann	180	190	290	290	290	290	290	290
ACESITA	75	49	120	120	120	120	120	120
Minas Gerais Coval	205	300	450	450	450	450	450	450
CSBM	-	120	120	120	120	120	120	120
Others[2]	496	552	552	567	589	609	682	642
Total Brazil	2,663	3,511	4,482	4,797	4,779	7,999	9,312	9,082
Chile								
CAP (Huachipato)	369	500	500	500	1,000	1,000	1,000	1,000
Others[2]	29	37	41	49	50	59	60	65
Total Chile	398	537	541	549	1,050	1,059	1,060	1,065
Colombia								
Paz de Río	160	170	170	170	170	290	290	600
Others[2]	30	33	36	39	36	37	38	39
Total Colombia	190	203	206	209	206	327	328	639

* A revision of this plan has increased the goal by almost 1 million tons

(Cont.)

Country and plant	Thousands of annual tons of ingot							
	1961	1964	1965	1966	1967	1968	1969	1970
Mexico								
Altos Hornos Monclova	523	600	950	1.050	1.100	1.250	1.250	1.250
Fundidora Monterrey	278	500	500	750	750	1.000	1.000	1.000
Hojalata y Lamina	166	166	166	600	600	600	600	600
Rio Las Truchas	-	-	-	-	-	500	500	1.000
La Consolidada	151	160	160	160	200	200	200	200
Est. Sonora	-	-	-	-	120	120	120	200
Others a/	564	615	632	650	670	690	710	732
Total Mexico	1.682	2.041	2.408	2.960	3.190	4.360	4.380	4.982
Peru								
Chimbote	74	75	75	250	250	250	250	250
Total Peru	74	75	75	250	250	250	250	250
Uruguay								
Valentines	-	-	-	-	-	100	100	100
Others a/	9	15	16	17	18	19	20	21
Total Uruguay	9	15	16	17	18	119	120	121
Venezuela								
Orinoco	-	350	700	700	700	1.200	1.200	1.200
Others a/	71	77	80	82	85	87	91	94
Total Venezuela	71	427	780	782	785	1.287	1.291	1.294
Central America								
Honduras	-	-	-	-	-	100	100	100
Total Central America	-	-	-	-	-	100	100	100
Grand Total	5.304	7.978	9.377	11.628	12.625	18.782	19.742	21.485

a/ Including all integrated or semi-integrated plants that have not been specifically mentioned in relation to expansion plans or new projects. In 1961 they produced, taken together, some 1,545 tons of ingot steel, or about 33 per cent of total output. Most of them have expansion plans which individually do not warrant mention here but their expansion potential must be taken into account when studying the future prospects of the Latin American steel market. Here, an annual cumulative increase of 3 per cent in production has been envisaged, which is in the aggregate a very conservative figure.

Four, transportation facilities have proven to be a drawback. Those which function between Latin American countries are both limited and expensive to operate. As a general rule, ocean freight charges from New York to Latin America are often lower than freight charges between two adjoining Latin American countries.

For those reasons steel production in most Latin American countries has been planned as a substitute for a limited range of imported steel products. The demand for steel products within the countries comprises a number of product categories, and unfortunately the demand for many of these individual products is too small to support their economic production.

Steel Production in Latin America during 1960-1963

The record of 1963 is indicative of the progress made by the Latin American steel producers in overcoming many of their problems. Practically all of the steel producing countries participated in the 1.1 million ton increase in production. The degree of their participation is indicated by the following table which lists crude steel production for the Latin American countries for the period 1960-1963. It will be noted that the most sizeable increases in production during 1963 were achieved by the three largest steel producing nations, Mexico with 308,000 tons, Brazil with 276,000 tons and Argentina with 250,000 tons. The major relative increases in production occurred in Venezuela at 152 per cent, Columbia 42 per cent and Argentina at 39 per cent. Minor declines in production were experienced in Chile and Uruguay.

Latin America: Planned Additions to Iron and Steelmaking Facilities

Mexico:

Altos Hornos de Mexico, S.A.

Ore Preparation: Bedding and sintering facilities with aggregate capacity of 4,000 tons per day.

Ironmaking Facilities: A 22 ft. 6 in. hearth blast furnace with requisite auxiliary facilities.

Steelmaking Facilities: Additional one open hearth furnace and a small oxygen plant.

Rolling Facilities: A 3-stand tandem hot mill and billet and bar mill; a 5-stand cold reduction mill and a 2-stand temper mill.

Finishing Facilities: New wire mill and wire finishing equipment.

Cia. Fundidora de Fierro y Acero de Monterrey, S.A.

Ironmaking Facilities: One 28 ft. diameter blast furnace with auxiliary equipment.

Steelmaking Facilities: Two 300 net ton open hearth furnaces.

Rolling Facilities: One 26 in. semi-continuous billet mill and one 21 and 56 x 56 in. 4-stand, 4-high tandem cold mill.

Finishing Facilities: One caustic cleaning line, one flying shear line and one slitting line.

Miscellaneous: One set of annealing furnaces, one 6-hole soaking pit, one 100 ton per hour slab reheating furnace.

Siderurgica Nacional, S.A.

Steelmaking Facilities: Electro furnace capacity addition equal to 10,000 tons annually.

Miscellaneous: A bar mill, forging press, conditioning equipment, annealing furnaces and heat-treating furnaces.

Argentina:

Zapla Iron and Steel Work (1964)

A charcoal blast furnace, open hearth steelmaking furnaces and miscellaneous rolling mill equipment.

Gurmendi, S.A., Industria Metalurgica

Ironmaking: Approximately 300,000 tons of ironmaking capacity per year.

Steelmaking: Two 20-ton LD converters, total annual capacity 200,000 tons. A continuous costing machine for billets.

Rolling and Finishing: A rod mill due to be completed in 1964; a wire drawing plant and galvanizing facilities.

Brazil:

Cia Ferro e Aco de Vitoria, S.A.

Blooming and billet mills scheduled to begin operations in 1964.

COSIPA

Ironmaking: One 2,000-ton blast furnace.

Steelmaking: Two 75-ton oxygen converters.

Ore Preparation: A sinter plant.

Rolling Mill: Blooming mill, plate mill and cold reduction mill in operation during 1964.

Miscellaneous: Six 2-hole soaking pits, two 31 oven coke batteries, and oxygen producing facilities.

"Usiba"

Ironmaking: Direct reduction plant -- Hyl sponge iron.

Steelmaking: Two 90 ton electric furnaces.

Chile:

Compania de Acero del Pacifico, S.A.

Iron and Steelmaking Facilities: The addition of a 20 ft. 9 in. diameter blast furnace and the enlarging of existing open hearth furnaces.

Miscellaneous: An electrolytic tinning line and a slab reheating furnace.

Colombia:

Aceriaa Paz del Rio, S.A.

Ore and Raw Material Preparation: Additions to coa. working facilities, revision to limestone and coal blending plant, and improvements to lime plant.

Ironmaking Plant: The addition of new turboblowers, the modification of gas cleaning facilities, fuel injection and additional iron ladles.

Steelmaking Plant: a 25-ton oxygen plant, and additional ingot molds and buggies.

Rolling Mills and Equipment: A 56 in. blooming and slabbing mill, mill cranes and descaling equipment.

Miscellaneous Equipment: A new galvanising line,strip shearing and slitting facilities, soaking pits, slab reheating furnaces, annealing furnace and other internal improvement.

Peru:

Sociedad Siderurgica de Chimbote S.A.

Iron and Steelmaking: A 550-ton per day blast furnace, a 900-ton hot metal mixer, two 2[illegible]-ton oxygen converters and a 4-stand continuous casting machine for billets.

Miscellaneous Addition: An oxygen making plant and enlargement of existing merchant mill.

It will be noted from the information above that Latin America's steel expansion plans are indeed ambitious, and before they are realised a number of concrete problems which currently face the economies of Latin America must be resolved. Two of these which head the list are the lack of capital resources and the lack of human resources.

Steel Investment and Capital Availability in Latin America

The Latin American steel industry has been built largely with outside capital obtained from a number of sources, but principally from the public agencies such as the Export-Import Bank, the World Bank and the Bank for Inter-American Development. The Export-Import Bank alone has extended to Latin America long-term loans aggregating about one-half billion dollars. Additional financing for steel projects has come from Europe, particularly from France, Germany and Italy, and recently Japan has provided capital for steel plant construction in Brazil. In addition, the steel equipment makers have extended credit on a long-term basis. This experience is contrary to the preferred situation wherein a substantial part of the required investment capital is obtained from local sources. The necessity to rely on outside financing stems from a problem which is common in many developing economies, namely that inflation acts to discourage the accumulation of investment funds through savings and also lending by local agencies on a long-term basis.

Inflation

The three-fold expansion of steel capacity which is planned in Latin America will require a tremendous amount of capital, and the extent to which this will be obtained through the continued reliance on outside sources will depend to a great degree on the ability of the Latin American countries to control the inflationary trends that are characteristic of many of their economies. During 1964 the rate of inflation was approximately 45 per cent in both Argentina and Chile and approximately 80 per cent in Brazil. These rates far exceed the rates of interest paid on savings so that it has been nearly impossible to attract savings sufficient to support long-term loans of the magnitude required for basic investment such as that in steel plant and equipment.

The problem of inflation cannot be solved within a short period of time, since an abrupt action would most likely damage the young industries currently in operation in many Latin American countries. However, effective gradual measures must be taken to cope with the problem for under present inflationary conditions sizeable outside borrowings constitute an intolerable burden on the foreign exchange positions of the borrowing countries. Only by acting to check inflation will the area be able to reduce its dependence on outside capital sources to a significant extent.

Steel Expansion and the Availability of Skilled Labor

The second shortage which Latin America faces is that of sufficient numbers of competent trained personnel. At the present time the industry in Latin America has no surplus of trained personnel on any level. The expansion of 200 per cent which is contemplated in the next six or seven years will require the training on a number of levels of people competent to operate steel mills successfully. At the recent meeting of ILAFA in Mexico City the subject of adequate technically trained personnel received a great deal of attention and it was generally agreed by those in the industry that this was Latin America's greatest need at present. Therefore, a concentrated program of training and development must be undertaken if the ambitious plans which are projected for the next seven years are to come to fruition.

Another basic problem which must be solved in many areas of Latin America before a substantial addition can be made to the steel industry is that of adequate economic infrastructure. The transportation facilities which include not only railroads but highways and water operations, as well as the amount of available electric power must be improved and increased if the steel industry

is to function well. A concerted effort has been made throughout Latin America to improve this,but much remains to be done. Electric power is currently inadequate, rail transportation and highway transportation leaves much to be desired, and sizeable investments must be made to improve these facilities so that not only the steel industry can function, but also that the economy can grow and provide a better market for its products.

In the short run it is evident that other problems must be met for it will be necessary that outsiders be brought in to help run the mills now under construction or contemplated. Provision must be made for these people so that they will be able to live in harmony with those with whom they will have to work.

The technical problems involved with raw material beneficiation and steel mill operations can be solved, if the aforementioned difficulties are removed.

There are a number of developments which have taken place in the technology of iron and steelmaking which can be of significant help to Latin America in achieving the stated goals. Among these are: 1) the increase in blast furnace output which can be achieved by the improvement of the burden with a relatively small additional investment through the use of beneficiated ores and improved coking coal. Pelletising and sintering have done much to increase the output of blast furnaces without increasing their size in the last ten years; 2) the use of oxygen in the open hearth furnace which has resulted in a reduction in investment requirements per ton of product produced. A caution must be expressed here because there are some Latin American steel companies that have a high phosphorous ore and, consequently, make pig iron with a high phosphorous content which to a great extent limits the application of oxygen. However, where this type of iron is not used, oxygen can be employed with considerable

benefit; 3) the development of continuous casting which makes possible the installation of an integrated steel operation with substantial reduction in investment costs. This is particularly applicable at the present time for billets and blooms. However, there is some reservation on its application to wide slabs for sheets.

These recent technological developments in addition to reducing the investment required in a steel plant per unit of output also affect the economies of scale of the industry so as to permit the construction of economical plants of smaller capacity than was heretofore possible. By supplying not one product but a limited range of products, significant economies of scale might be achieved in a small integrated steel plant.

FAR EAST

This area is a vast expanse which encompasses the continent of Australia, Japan, the Chinese Mainland, Malay States, the Philippines, New Zealand and a number of other islands, large and small. There are actually three steel producing countries in the area, namely, Japan, the Chinese Mainland and Australia. Some of the remaining countries have recently established very small steel operations, however, their tonnage is quite limited. Other countries in the area produce virtually no steel so that these and the small producers are dependent on the outside world for their steel requirements. A great portion of this imported steel comes from Japan. This country which was prostrate in the immediate post war years has expanded its steel industry to such a remarkable extent that in 1964 it was the third largest steel producer in the world with an output of 42 million net tons. Since Japan must import the vast bulk of its steelmaking raw materials, it is necessary that it export a substantial quantity of finished steel products to balance its trade. Japan currently imports 90 per cent of its iron ore, approximately 60 per cent of its coal for use in steelmaking and a large portion of its scrap requirements. Iron ore imports come principally from India, the Malay States and South America. These three areas account for approximately 75 per cent of the total tonnage while the remaining 25 per cent is drawn from a number of countries throughout the world. Coal comes from Australia and the United States.

In 1964 exports of steel from Japan were some 7 million tons. As a consequence, Japan is the dominant industrial force in the Far East and, in fact, has spread its products throughout the world. Thus any consideration of the steel industry in this part of the world must be related to developments in Japan.

At the present time the Japanese steel industry has plans for expansion which will bring its capacity to 55 million tons by 1970. It seems certain that this goal will be attained for at the present time each of the six largest steel companies is expanding its capacity by at least 1 million tons while one is actively working on a new plant which will add 6 million tons to its capacity by 1970.

All of the added plant will be located on the tidewater, as is most of the present industry. Further, Japan is planning to build larger bulk cargo carriers then are in operation today. These ships will be capable of carrying 75,000 to 100,000 tons of cargo and will make the transportation of raw materials more economical than it is currently. In fact, Japan will be in a comparable position with those countries that have raw materials within their own borders and must transport them to their steelmaking facilities by rail.

The additional tonnage will mean increased exports and this will tend to sharpen competition in the Far East and, perhaps, throughout the world.

Table III-4

Latin American Crude Steel Production, 1960-1963
(thousands of metric tons)

Country	Production							
	1960	% total	1962	% total	1963	% total	1964	% total
Argentina	277	6	442		[illegible]	11	[illegible]	13
Brasil	2200	47	2483	46	2565	48	[illegible]	40
Chile	450	10	391	7	[illegible]	9	[illegible]	8
Columbia	172	4	198	4	157	3	[illegible]	3
Mexico	1474	31	1602	32	1709	29	[illegible]	29
Peru	59	1	75	1	71	1	76	1
Uruguay	10		9		9		7	
Venezuela	47	1	71	2	142	3	359	6
Totals	4749	100	5305	100	5626	100	6987	100

Source: Revista Latinoamericana de Siderurgia, No. 50/51, June-July 1964 pp. 26-27

Table III-5 breaks this production down according to the steelmaking processes. Most of the steel was melted in Open Hearth furnaces which in 1963 contributed 4.7 million tons of output, or roughly two-thirds of all the steel produced. The second most widely used process was the electric furnace, which in 1963 contributed almost one-quarter of total Latin American output. The basic oxygen converter (LD) melted 383,000 metric tons of steel in 1963 and it should be noted that all of the LD capacity in the area was located in Brasil.

China (Mainland)

The steel industry on the Mainland of China has had a number of fluctuations in the last five years. Production as reported from 1959 through 1963 shows a very unusual trend when compared with the rest of the world. The following figures for these five years indicate a sharp drop in production from 1960 to 1962 with but a minor recovery in 1963.

1959	14,695,000
1960	20,337,000
1961	13,200,000
1962	8,000,000
1963	8,300,000

This is the only large nation that has shown such a decline in steel production during this period.

Australia

The other large steel producing country in the Far East is Australia where 5,114,000 tons were produced in 1963 and approximately 5,300,000 for 1964. Australia has achieved a definite degree of industrialization, however, its possibilities for future expansion are so great that in one sense it could be called a developing economy.

Australia was among the top fifteen nations of the world in steel production in 1963, and there are plans to increase output by 50 per cent within the next three to four years. Quite recently vast rich deposits of iron ore have been discovered (estimates range up to 10 billion tons) which will not only provide for the needs of Australia for decades to come, but will also make possible the development of an export trade in iron ore which may supply much of the total requirements of the Far East and may even extend to steel producing countries

in the West. In fact, contracts have been made to ship ore to Japan beginning in August 1966. The total amount contracted for is 65 million tons to be delivered over a fifteen year period at a price of $600 million.

Australia also has large deposits of coal which will take care of its steel industry for many years. In 1962, because of a recession in the country, some 700,000 tons of steel mill products were exported. This was, however, a most unusual case and is not likely to recur in the near future for the steel industry in Australia will be quite busy in normal years providing for domestic requirements.

In 1963, exports fell to 280,000 tons much of which went to New Zealand and in the first half of 1964, because of great domestic demand, exports dropped to 75,000 tons.

Basically, the industry in Australia consists of one company, The Broken Hill Proprietary Co., Ltd. It has two large plants; one in Newcastle, the other at Port Kembla, and is currently bringing a third into operation near Adelaide. By 1970 production will be in excess of 8 million tons if current expansion plans materialise, and there is no foreseeable reason why they should not. The financing for this expansion will most probably come from the internal resources of the company, and if it is slowed up at all it will be because of inadequate manpower to construct and operate the facilities. The one basic problem which faces Australia today is the lack of people, for the population of that vast continent is about 11 million. At the present time, although the industry in Australia is quite diversified, there is still a need for imported steel, some of which comes from Japan.

<u>New Zealand</u>

New Zealand has been an importer of iron and steel and only recently

has established a small steel melting operation with two electric furnaces of 20 ton capacity each and a small bar mill for rolling concrete reinforcing bars.

In 1962, there were 375,000 tons of steel mill products imported. These came principally from three sources: 1) Australia which accounted for 175,500 tons; 2) the United Kingdom with 114,600 tons; and 3) Japan with 60,000. The product mix included 24,900 tons of rails and equipment, 117,000 tons of light and heavy structural sections, 136,300 tons of flat rolled products, 49,000 tons of wire products and 38,400 tons of pipe and tubes. The extent and variety of imports indicates a substantial domestic consumption of steel by its 2,500,000 inhabitants.

In December 1964, the Report of the Provisional Board of the New Zealand Steel Company was released. This was the result of a study undertaken in New Zealand to determine whether or not a steel industry should be established there. The report recommended favorable action and thus it appears that within the next few years there will be additional steelmaking facilities established in New Zealand.

The plant calls for development in several stages. The first stage which is scheduled for completion in 1970 will provide a capacity for approximately 190,000 tons of products. Only three are contemplated, namely, billets, wire rods and galvanized sheets. The billets and wire rods will be rolled from steel made in New Zealand, while the galvanized sheets will be made from imported cold rolled steel coils. The industry will use local ores which are iron sands with a content of 56 to 59 per cent iron. There are 150,000,000 tons of this material available and it will be smelted in an electric furnace because the sands have a high titanium content which rules out their reduction in the conventional blast furnace. In the actual steelmaking process both the electric furnace

and oxygen converter will be used. The plans also call for continuous casting for billets and the necessary rolling mills to produce the product lines required.

It is estimated that the cost of the mill in the first stage will be about $40,000,000. This will be financed with overseas borrowing as well as New Zealand money in the form of loans and equity capital.

New Zealand has the coal which will be required for the reduction of iron so that the raw materials are available for the plants operation when it gets underway.

The domestic demand for steel products in New Zealand has approximately doubled since 1950 to its present level of about 400,000 tons. A projected rate of growth per annum of over 4 per cent would bring demand in 1970 to about 530,000 tons. The estimated product breakdown for the projected 1970 demand is as follows:

	(thousands of tons)
Angles and ties	17.9
Bars, Rods, etc.	111.0
Channels and girders	40.9
Plate and sheet	217.6
Other	23.4
Wire	74.4
Pipe and fitting	42.0
Total	530.2

Should domestic demand reach the levels indicated by the 1970 projection, a local plant would substantially reduce the need to import steel and thereby result in noteable foreign exchange savings. This is clear, for the first stage

of the mill alone would reduce the need for imports by about one fourth while successive stages would bring about additional reduction in the demand for imports.

At the present, the proposed plant is aimed only at the domestic market, but the possibility of exports has not been totally discounted. However, any export activity would likely be small due to the extent and nature of the domestic markets.

The Philippines

No steel was produced in the Philippines before World War II. Since that time, however, a number of small electric furnaces have been installed to make steel by melting the scrap which was left in the Philippines as a result of the war. In 1962 there were five such operations which produced about 100,000 tons. In addition to the electric furnace plants, there were five finishing facilities which coated steel sheets either with zinc or tin to make tin plate and galvanized sheets. These operated on imported steel and had a capacity to produce over 200,000 tons a year; production, however, was far short of this.

As early as 1952, plans were made for an integrated plant in the Philippines. There were many delays and postponements, but finally in 1964 the stage was reached where the Government secured a loan from the Export-Import Bank in the United States of some $62.5 million in order to carry out the project. The entire cost will be $115 million. Thus the Export-Import Bank will contribute a little more than half. The mill will be located in Mindanao and will have six low shaft electric smelting furnaces to reduce iron ore. The steelmaking facilities will consist of two 60 ton basic oxygen converters capable of an annual output of 350,000 tons.

The plant will be able to ship 275,000 tons of finished products which will be principally cold rolled sheets and tin plate. The operation will use

Philippine ore, but will have to import coke for the iron smelting.

Plans for an additional plant are also being drawn at the present time. This would be a second integrated mill to be located near Manila and would consist of a blast furnace with a capacity for 850 tons per day, an oxygen converter with a 30 ton capacity and a continuous casting machine for billets. The entire complex will cost approximately $60 million, much of which will be raised by a loan from Germany. This mill is intended to produce billets to supply the bar mills currently operating in the Philippines on imported semi-finished steel. The projected capacity is 250,000 tons of billets annually which will be cast in a curve mold, 8 strand continuous casting machine.

These two plants will establish the Philippines in the steel industry on an integreated basis for the first time and will make the island the fourth largest steel producer in the Far East. There are other plans under way for the expansion of existing mills, but they are small by comparison with the two above mentioned projects. One is a continuous casting unit for billets which will have one strand, and another plan involves the expansion of one of the tin coating plants in operation today.

The Philippines is an example of a developing country which has entered the steel business on an integrated basis with a relatively small investment. The products which will be produced will meet a definite growing demand, but are not sufficient to satisfy it completely. Other types of steel products must be imported, as well as some tonnages of the products to be made domestically since the planned output will not meet the total demand for these products.

The total investment for the two proposed integrated plants, namely, $175 million, is substantial by any standards and it would be extremely difficult for developing countries to obtain this much capital without outside held.

However, the additions which are contemplated for the smaller mills, namely, the one strand continuous casting machine for billets, represent a much smaller capital investment.

The two new mills are to be operated in the private sector of the economy. This was a decision made by the Government some time ago, for in the Philippines the Government's role has been confined to suggesting the type of industry to be developed and then guaranteeing the loan which is obtained from outside sources. In addition to the guarantee of the external financing, the Government has helped with some financing of its own. In the case of the smaller integrated mill, the Government will lend $7 million to the operating organization.

Singapore

One of the smaller steelmaking operations in the Far East is in Singapore where the National Iron and Steel Mills, Ltd., has an electric furnace and a bar mill. The furnace has a capacity of 25 tons and a total annual production of between 40,000 and 50,000 tons. When installed, the equipment was new and not second hand, and therefore, represents an investment of several million dollars. The principal products are concrete reinforcing bar and some small structural shapes. There are plans at present to double the output by adding another electric furnace of 25 ton heat capacity. Thus the mill will be able to produce 100,000 tons of ingots when this expansion is completed.

The raw material is scrap and a good percentage of this is obtained from dismantling old ships. The plants' location on the tidewater make this operation quite economical.

The developing countries of the Far East are importers of steel for their production, where it exists, is by no means adequate to care for the demand, hence they are heavily dependent upon the industrialized nations of the world for

their steel products. Therefore, a complete study of steel requirements in these nations must include an analysis of their imports in terms of products and the country of origin.

Total imports for these countries in 1962 were approximately 2,219,400 tons of various steel products. The leading importers were: Hong Kong with 311,900, the Philippines with 244,100, Thailand with 241,900 tons and Indonesia with 238,600. The imports of these four countries accounted for almost half of the total for the Far East.

The breakdown of imports in terms of products reveals that flat rolled products and structural sections are by are the most significant. In fact, in 1962 flat rolled products imported into this area amounted to 937,300 tons and structural sections represented a substantial figure of 540,200 tons, but were definitely far behind flat rolled products. Tubes and wire products were third and fourth with 142,000 and 114,400 tons, respectively.

The principal countries of origin were Japan, the United States, Australia, Russia, Poland, Belgium-Luxemburg, Germany and France. Japan, because of its increased steel production and geographic location, was the principal supplier providing almost half of the total. The following is a further breakdown of the import figures for the Far Eastern countries. It includes a list of the countries receiving imports and the country of origin, as well as the type of steel product. The figures are for the year 1962.

Burma

In 1962 more than half of Burma's 98,300 tons of steel imports originated in Japan which shiped 54,000 tons. The U.S.S.R. with 13,400 tons and Australia with 14,300 tons were the only other significant exporters to Burma. These imports included 49,400 tons flat rolled products, 11,000 tons of railway material and 9,000 tons of sections.

The China Mainland

Of China's 185,600 tons of steel imports in 1962, 96,700 tons came from the U.S.S.R., 55,000 tons from Japan, 10.1 tons from West Germany and 10.1 tons from the United Kingdom. China imported 93,700 tons of flat rolled production, 36,900 tons of tubes and 22,800 tons of wheels, tyres and axles which together represented approximately 85% of the total figure.

China Taiwan

Japan was the major supplier in Taiwan's total imports of 154,900 tons of steel production. The Japanese accounted for 125,000 tons of this amount. In terms of products, Taiwan received 102,500 tons of flat rolled and 25,000 tons of various wire products.

Federation of Malaya

In 1962 Malaya imported 175,000 tons of steel. The leading suppliers of steel were: Japan, 90,000 tons, the United Kingdom, 33,600 tons and Belgium-Luxemburg, 18,000 tons. The exporting countries shipped 55,400 tons of sections and 56,800 tons of flat rolled products.

Hong Kong

In 1962, most of Hong Kong's 311,900 tons of imports came from Japan which supplied 168,000 tons. The United Kingdom followed with 77,600 tons and then Australia with 28,400 tons.

Structural sections were the largest import with 161,000 and flat products were second with 109,400 tons.

Indonesia

Indonesia's 258,600 tons of steel imports in 1962 were principally shipped from Japan which accounted for 101,000 tons, West Germany was next with 67,500 tons followed by the United States with 21,600 tons and Belgium-Luxemburg with

14,000 tons. The principal imports by products were 47,300 tons of sections and 60,800 tons of flat rolled products.

North Vietnam

The U.S.S.R. shipped 29,800 tons of steel to North Vietnam and this comprised most of the 35,000 ton total. A product breakdown was unavailable.

Philippines

Imports during 1962 totaled 284,100 tons for the Philippines. Japan's 168,000 tons along with the United States' 32,200 tons, Belgium-Luxemburg's 14,000 tons and Australia's 11,600 tons comprise most of the Philippines' total. The major product groups included 146,000 tons of flat rolled, 30,900 tons of structural sections and 27,000 tons of wire.

Republic of Korea

In 1962, Korea imported 168,200 tons of steel of which 142,000 tons came from Japan and 17,000 tons from the United States. The total amount of imports included 25,400 tons of structural sections and 96,900 tons of flat rolled products.

Republic of Vietnam

In 1962, 64,000 tons of steel were exported to Vietnam. A substantial portion of this tonnage came from the United States which shipped 23,200 tons. Japan and France accounted for 15,000 tons and 8,300 tons respectively. The product mix included 29,700 tons of flat rolled products and 16,800 tons of structural sections.

Thailand

In 1962, 191,000 tons of steel from Japan, and 17,000 tons from the United States represented the major part of Thailand's 241,900 ton total. The major products were, 97,300 tons of structural sections, 99,500 tons of

[illegible]

Country	Steel Production	Distribution by Processes				
		[illegible]	[illegible]	Open Hearth	Electric	[illegible]
Argentina	[illegible]			[illegible]	[illegible]	
Brazil	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
Chile	[illegible]			[illegible]	[illegible]	
Colombia	[illegible]	[illegible]			[illegible]	
Mexico	[illegible]			[illegible]	[illegible]	
Peru	[illegible]	[illegible]			[illegible]	
Uruguay	[illegible]			[illegible]		
Venezuela	[illegible]			[illegible]	[illegible]	
Totals	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Source: [illegible]
[illegible]

If one examines the period under consideration a sharp acceleration in the growth of steel production is evident in some of the Latin American countries. This is particularly true of Argentina which increased its production from [illegible] metric tons to [illegible] metric tons. At the same time Argentina's share of total Latin American production increased from 6 percent to 11 percent.

The remarkably rapid development was spear headed by SOMISA a company which was founded in 1960 and has since then installed a blast furnace of about 28 feet hearth diameters and four open hearth furnaces capable of producing 429 ton heats.

Argentina is lacking in raw materials and must import its ore and coal. Ore has come from Chile and coal from the United States.

flat rolled products and 23,000 tons of wire.

In addition to the aforementioned countries, those importing smaller amounts were: Laos with 400 tons, North Korea with 12,200 tons and a number of smaller countries and islands with a total of 284,200 tons of steel.

The substantial demand for steel products which exists in the Far East is expected to grow steadily during the next decade. This growth will be particularly rapid in those countries which produce at present little or no steel. Their per capita consumption is currently quite low and any industrialization will require that this be stepped up appreciably. Much of this increased demand will be supplied by Japan with its continually growing steel industry and some of it will be taken care of by domestic production, particularly in those countries which plan to construct steelmaking facilities.

Japan will supply finished products of many types and also steel for further conversion. The latter category will be principally hot and cold rolled strip to be galvanized or tinned. Semi-finished steel, such as billets which are in great demand, will be made by the countries themselves by continuous casting units. This is a trend already quite pronounced and a number of installations have already been planned or contracted for. The steel for the most part will be made in electric furnaces before being cast. Billets are in demand throughout the Far East for small rolling mills and the Japanese do not find it particularly attractive to sell them, for they are not a profitable item. As has been stated, Japan must import virtually all of its raw materials and consequently, ingot costs are high. It is only in terms of the finished product that cost savings can be affected and steel produced economically. Billets do not represent enough man hours to come in this profitable category and, therefore, the Japanese are content to see semi-finished steel provided by someone else, if they can sell the finished product.

The possibility of realizing the goals and objectives set by the various countries in the Far East depends on availability of raw materials, capital funds and skilled labor. The steelmaking operations which are contemplated involve both ore smelting operations and electric furnaces. In the first instance the basic raw materials for steelmaking are required, namely, iron ore; fuel, usually coke, and a fluxing agent. In the second instance the "raw material" is primarily steel scrap, although the product of the direct reduction process for iron ore is also used in the electric furnace.

From the point of view of raw materials, the Far East, particularly with the above mentioned discovery of iron ore in Australia, as well as the supplies in the Malay States and neighboring India, is well supplied. The ore is rich in iron content and the present tendency toward pelletization should make it an excellent blast furnace burden. On of the exceptions to this is New Zealand where iron sands with about 57 per cent iron content but also high in titanium cannot be reduced in the blast furnace.

Coal is not found as plentifully or in as high a quality as ore, however, there are supplies in Australia which can take care of much of the demand in the Far East. There is even reason to believe that coal will continue to be imported from outside of the area in the next decade in order to meet the full requirements.

Near and Middle East

For purposes of this study the Near and Middle East will include the following countries: Bahrain, Ceylon, Egypt, India, Iran, Iraq, Israel, Kuwait, Lebanon, Pakistan, Saudi Arabia, Syria, Turkey and the remaining countries which are found in this general geographic area.

In the area of India is by far the dominant steel producer. Turkey produces a limited amount of steel, but has just finished the construction of a new mill which went into operation in the spring of 1965. Pakistan has a steel mill under construction at the present time, while Egypt and Israel produce small amount of steel.

India

India is the largest country in the Middle East both in territorial size and number of people. Since the end of World War II and 1947 when it attained independence, great strides have been made in steel production. Before the War there were two plants in existence in the private sector of the economy with a combined capacity of less than 1 1/2 million tons. These expanded somewhat in the immediate post war years and in the late 1950's the Government made the decision to build a steel industry which would be operated in the public sector. Three plants were constructed, one by the British at Durgapur, one by the Russians at Bhilai and one by the Germans at Rourkela. Each had a rated capacity of 1.1 million ingot tons. By this time the private sector had increased its capacity to about 3 million tons so that in the early 1960's the capacity of the Indian iron and steel industry was approximately 6 million tons. This production was not actually attained until 1963 when 6.6 million net tons of crude steel were produced.

Total crude steel production in millions of tons for the past few years was:

1956	1.9	1961	4.5
1957	1.9	1962	5.6
1958	2.0	1963	6.6
1959	2.7	1964	4.9 (9 mos.)
1960	3.6		

Currently there is an expansion program underway at all three of the plants in the public sector. The 3.3 million ton capacity will be expanded to approximately 6 million tons. Further, a fourth plant has been planned in the public sector which has been the subject of much discussion over a period of years. It is intended to have an initial capacity of about 1.5 million tons and ultimately, in the third phase, of 4 million tons.

The Hindustan Steel Company which is the public company, and the Indian Iron and Steel Company and Tata Iron and Steel company, which are the private companies, combine to produce a full range of steel products. The product mix for the five plants is as follows:

<u>Public Sector Product mix</u>:

a. Bhilai:	b. Durgapur:	c. Rourkela:
Rails	Heavy structurals	Plates
Ties	Forging blooms	Hot rolled sheets/strips
Heavy structurals	Ties	Cold rolled sheets/strips
Rounds	Light structurals	Tin plates
Billets for re-rolling	Billets for re-rolling	
	Railroad wheels, tyres and axles	

Product mix for Indian private sector plants:

a. Tisco:

- Rails
- Ties
- Heavy structurals
- Bars
- Hot rolled sheets
- Cold rolled sheets
- Galvanized sheets
- Skelp and strip
- Plates
- Railroad wheels and axles
- Billets for re-rolling

b. Iisco

- Rails
- Heavy structurals
- Bars
- Hot rolled sheets
- Cold rolled sheets
- Galvanized sheets
- Billets for re-rolling

The new plant which is to be located at Bokaro will be exclusively a flat products plant and at the present stage of its development it would seem that the plant will not start operations until late 1967 or 1968. And it has been estimated that it will not operate profitably until the second stage of 2.5 million tons has been reached.

India's plan to develop an extensive steel industry to take care of a large part of its steel requirements is based on the desire for a high degree of economic independence and the need to improve its foreign exchange position. In addition to steel, plans have been made and are being carried out currently to develop an industry for the production of heavy industrial equipment.

The basic raw materials for the production of steel are presently in abundance throughout the country. The reserves of coking coal have been estimated at 1.6 billion tons. In the decade of the 1950's, the production

of coking coal has risen from approximately 8 million tons to more than million tons a year. Unfortunately, the coal which is now being mined has high ash content ranging from 24 per cent to 30 per cent and thus it is necessary to wash the coal so that the ash content may be reduced to approximately 17 per cent. This still leaves a somewhat unsatisfactory situation and will require blending of these coals with others in order to produce a better blast furnace burden.

With the relatively limited amount of coking coal, India may well face a problem in regard to this essential raw material sometime in the next decade, particularly if the expansion plans to produce 19 million to 20 million tons of steel by 1972 are realized and, much more so if the level of production by 1977 reaches the present proposed goal of 28 million tons. It will be necessary to import coking coal from other parts of the world, but with the trend to large bulk cargo carriers, the cost of coal imports will be considerably reduced and this is regarded as preferable to importing additional steel.

Iron ore reserves in India are quite extensive ranging up to 20 billion tons. Many of these deposits have a rich iron content up to 60 per cent, however, much of it contains a fairly high amount of alumina. Further, the Indian ores have a high percentage of fines and thus will require sintering or pelletizing in order to get maximum yield.

In regard to limestone, the third basic raw material for the production of pig iron, India faces a problem, for the high grade stone, particularly that located near the steel plants, is limited in quantity and that which is available in large amounts has a high percentage of silicon, therefore some means must be found to beneficiate the limestone in order to insure higher productivity in the blast furnaces.

India's difficulties with raw materials for steelmaking are part of the problem in developing a full scale steel industry which will meet a large share of its domestic needs. To operate the industry successfully more skilled technicians must be trained and the infrastructure of the economy must be considerably improved. Further, every attempt must be made to increase productivity in the steel industry so that the operation may be rendered more efficient and economical.

It is not surprising that the country lacks sufficient personnel to operate a steel industry which was expanded so rapidly in the course of a few years. The shortage of skilled technicians made it impossible to operate the industry at capacity until 1963, and one of the prime difficulties in the current expansion program is the problem of training sufficient engineers and operators to man the expanded steel plants. In fact, it was 1963 before the number of trained personnel was adequate to man the plants. One of the areas in which training is particularly required is that of maintenance.

India has conducted an extensive program of training young college and technical school graduates and these have performed their functions well. However, more experienced personnel is required and these must be obtained from outside the country. There is no substitute for actual experience in the steel mill, and India has not been operating an extensive steel industry long enough to develop a large enough group of men with sufficient experience.

It will only be possible to increase productivity and thus reduce costs if modern technological developments are employed, and these must be installed at every level. The infractructure of the Indian economy, particularly in respect to transportation must be substantially improved. More rolling stock, particularly that necessary to handle steel products, must be provided. Further, the

developing steel industry will place a great demand on the power supply of the country, and before the full potential of steel operations can be realized, this demand must be satisfield.

These problems are not unusual for a developing country with a desire to expand its basic industry in a brief period. They have been experienced in all industrialized countries over the last century. However, the difficulty is accentuated by the desire to build basic industry as rapidly as possible, and very often a balance of the factors that would insure smooth industrial development cannot be maintained.

In spite of its growing steel industry, India is still a large importer of steel. In 1962, approximately 471,000 tons of flat rolled products, 194,000 tons of rails and track material and 140,000 tons of bars were imported. These and other products brought the total to more than 1 million gross tons. Indian imports have declined somewhat, but in 1963 they were still approximately 900,000 gross tons. The major sources of these imports are Japan, West Germany, the United States, Great Britain, and U.S.S.R. To help balance these imports India has developed a sizeable export market for its iron ore, much of which goes to Japan. Exports of ore have exceeded 3 million tons for the last four years and those of coal have been at an annual rate of one million tons during the same period.

The proposed plant at Bokaro, which is to be devoted to the production of flat products should be a major factor in filling the demands of the Indian market. The following projections for 1966, 1971 and 1976 indicate the extent and diversification of the market and the products which will be in demand.

(thousands of metric tons)

	Heavy Sections	Sections	Light Flats	Plates, Whls., Axles, Forg. Blooms and Specialties	Total Finished Product	Ingots
1966	1913	1855	1390	520	5678	7350
1971	2560	3241	2280	913	8794	11290
1976	3094	4831	2510	950	11185	14390

Whether or not this will be satisfied depends upon the ability of the Indians to solve the aforementioned problems.

Turkey

Turkey is the second largest steel producer in the Middle East. Its output of steel and related products has been increasing constantly since 1950, and during 1965 a much more notable advance will be recorded, as the new steel mill of the coast of the Black Sea goes into operation. Production figures of iron and steel, coke and iron ore for selected years indicate the growth already experienced.

(thousands of metric tons)

Year	Iron Ore	Coke	Pig Iron	Crude Steel
1950	233.6	73.3	113.5	90.8
1955	874.0	88.7	200.6	188.5
1959	872.9	100.3	236.2	214.2
1961	764.5	100.0	235.5	283.0
1962	814.3	84.6	222.0	242.6
1963	827.0	-	-	322.0

Source: British Iron and Steel Federation

The steel has been converted into bars and structural sections, rails and railroad equipment and relatively small tonnages of plate and sheets. For the Turkey economy during the 1950's it was quite normal that bars and structural sections should represent the major portion of steel used, as is indicated in the following table:

[illegible]

[illegible] approximately [illegible]. The goal is 3 million ingot tons. [illegible] larger integrated [illegible] such as [illegible], which produces primarily light flat products, plan a major [illegible] expansion of almost 1 million tons. COSIPA, which began with rolling facilities and plate and sheet from the Usiminas Company, will bring its blast furnace and open hearth steelmaking capacity into operation in mid 1965. Usiminas, on the other hand, which began with a blast furnace and steelmaking facilities of about 400,000 ton capacity, expects to have rolling mills operating by mid 1965. Of its two planned blast furnaces with hearth diameters of 22 feet, one is in operation. This plant, which was built with the aid of Japanese capital, represents a total investment of approximately $350 million. It has been coordinated with another mill, namely Ferro e Aço de Vitória, which has installed rolling mill facilities to produce light and medium shapes from ingots supplied by Usiminas.

Iron ore supplies in Brazil are plentiful and the quality is good. In addition to supplying its own needs, Brazil exports a considerable amount of ore, and is inaugurating a pellet plant in order to export pellets rather than the raw ore. Brazil at the present time imports 60 percent of its coal requirement from the United States and supplies the remaining 40 percent from domestic sources.

Finished Steel Products
(Thousands of Metric Tons)

Year	Bars and Sections	Plate and Sheets	Rails and Railroad Equipment
1950	55.7	11.8	10.5
1955	106.1	26.7	8.4
1959	118.2	32.9	6.3
1960	128.8	38.2	6.7
1961	86.1	25.5	10.1
1962	110.0	25.0	14.0

Source: British Iron and Steel Federation

The Turkey mill responsible for production to date was the Karabuck mill. Currently it has three blast furnaces, two with hearth diameters of approximately 16 feet and one 22 foot furnace. Steelmaking facilities consist of 6 open hearth furnaces capable of producing heats of 150 metric tons. The current ingot capacity of this mill is approximately 600,000 metric tons.

Up until the present time, Turkey has relied heavily on imports, which have averaged over 200,000 tons in the past few years. In 1962 total imports were 231,000 tons of which more than 100,000 tons were flat rolled products. These came principally from Belgium-Luxembourg, Germany, France and the United States.

The new Turkey mill located about 100 miles east of Istanbul on the Black Sea coast is a fully integrated plant which has 74 large coke

ovens, a 28 foot hearth diameter blast furnace, the largest in the Middle East, two 80 ton oxygen steelmaking converters and hot and cold rolling mills for flat products. The initial output will be approximately 500,000 tons of steel to be converted into blooms, scrap, plates, hot rolled sheets, cold rolled sheet and tinplate. This tonnage when added to the production of the Karabuck mill will give Turkey more than one million tons of crude steel production which should meet a large part of its steel needs.

The new plant will also offer 100,000 tons of pig iron for sale. The plant represents an investment of $250 million and will function on domestic raw materials which are more than adequate in quantity and quality.

Egypt

After India and Turkey the next largest producer in the Middle East is Egypt, although actually situated on the African coast, it is generally considered as part of the Middle East. For 1961 through 1963 crude production is listed at 165,000 tons each year.

The facilities for iron and steel production in Egypt consist of two small blast furnaces with a total capacity of 260,000 net tons, three Bessemer converts and seven electric arc furnaces. The steel is rolled into structural sections, plates, bars and sheets.

Egypt has plans for expansion which will increase its capacity in the future to 1 1/2 million tons. This is to be done by adding additional blast furnace capacity and oxygen steelmaking capacity.

The steel industry has been given priority in the second Five Year Plan,

and, in addition to the aforementioned expansion, a second mill is planned which will use energy from the Aswan Dam. Domestic iron ore and coal will be used for both mills. Much of the investment required to expand the existing mill will come from a loan of 360 million roubles to be granted by the U.S.S.R. Of this amount 145 million has been earmarked for steel expansion.

In 1962, total imports to Egypt were approximately 260,000 tons. This tonnage was spread over many products including ingots and semi-finished steel, pipe, wire rods, 75,000 tons of light and heavy structural sections and 27,000 tons of flat rolled products. The principal supplier of these imports were Germany, Poland, Hungary, France and Japan.

Israel

Israel is another country in the Middle East with a small product of steel. In 1963 the output amounted to 100,000 tons which was also the same for 1962. This came principally from one steel company which has two electric pig iron furnaces and two small basic open hearth furnaces of 45 ton capacity.

The finished products consist principally of concrete reinforcing bars which are rolled in a merchant mill.

Imports of steel products in 1962 were approximately 250,000 tons, 100,000 tons of which were flat products and 35,000 tons of structural shapes. The principal suppliers of these tonnages were West Germany, France, Belgium, United Kingdom and the United States.

Pakistan

There is virtually no crude steel production in Pakistan and, consequently, the more than 100 small rolling mills must depend on imports for their steel. These mills use principally billets which are rolled into light structural sections, concrete reinforcing bars, wire rods and bale

ties. In 1963 Pakistan imported 508,000 tons of which 379,000 came from the United States and about half of this was in the form of semi-finished steel, principally billets.* There were 90,000 tons of sheets and 43,000 tons of rails in addition to the semi-finished steel. Other major sources of steel for Pakistan were Austria, Japan and the United Kingdom.

In 1960 a study was undertaken to determine the feasibility of erecting a steel plant in West Pakistan. This study was supplemented by another one which was made in 1963 and submitted to the Government in 1964. They recommended favorable action and in March of 1965 an announcement was made that Pakistan would construct its first large tonnage steel plant with an annual melting capacity of 575,000 net tons. This project was to cost about $200 million. Case Study #2 presented above deals with this in some detail, thus there is no need to repeat here except to add that the projected company is to be known as the National Steel of Pakistan, Ltd. and a management and construction contract has been made with the National Steel Corporation of the United States.

Total imports of steel mill products to the remaining countries in the area were approximately 1,200,000 metric tons. The principal sources of these imports were:

a. Belgium-Luxembourg which exported 437,000 tons of steel products into this area of which 344,000 tons were in heavy and light structurals.

* In 1964 Pakistan imported 835,836 tons of steel mill products from the United States. Of these 419,163 tons were semi-finished steel, principally billets.

b. Germany which exported 271,300 tons into this area of which 34,000 were in ingots and semi-finished steel, 104,000 tons in structurals, 47,000 in flat rolled products and 60,000 tons in pipe and tube.

c. France which exported 230,000 tons of steel mill products into the area of which 122,300 were structurals, 44,000 in flat rolled and 29,000 in pipe and tube.

d. The United Kingdom which exported 133,600 metric tons of steel into the area of which 38,200 tons were in pipe and tube and 24,700 in structurals.

The major steel mill products imported into this area were structurals, flat rolled products and pipe and tubes. Imports by individual countries indicate the distribution of these steel products:

Bahrain: Steel mill product imports by Bahrain in 1962 were slight, totalling only 20,000 tons. Of this total, about 4,000 tons were in structurals, 4,000 in tube and pipe and about 9,000 in flat rolled products.

Iran: In aggregate terms, Iran imported in excess of 310,000 metric tons of steel mill products in 1962 which comprised a sizeable portion of total area imports. In terms of products, the major

steel mill products imported by Iran were 134,000 tons of structurals, over 50,000 tons of pipe and tube, as well as approximately 65,000 tons of flat rolled products.

Iraq: Total imports of steel mill products by Iraq in 1962 were in excess of 215,000 metric tons. The major products which Iraq imported were as follows: In excess of 117,000 tons of structural shapes, light and heavy, approximately 28,000 tons of flat rolled products and over 27,000 tons of pipe and tube.

Kuwait: This country imported about 108,000 metric tons of steel products in 1962. Of these, 56,000 tons were in light and heavy structurals and 34,000 tons in steel tube and fittings.

Lebanon: Export of steel products to Lebanon by the steel producing countries of the world totaled about 130,000 metric tons in 1962. The major products which made up the total were about 85,000 tons of structurals and 18,000 tons of flat rolled products

Saudi Arabia: Saudi Arabia imported in excess of 86,000 metric tons of steel products in 1962. Of this total, approximately 44,000 tons were in light and heavy shapes and 33,000 tons in steel pipe and fittings.

Syria: The imports of steel mill products by Syria in 1962 were in excess of 120,000 metric tons of steel. Here again the major products are light and heavy sections with over 75,000 tons and flat rolled products in excess of 28,000 metric tons.

Imports by other countries in this area which include Cypress, Jordan Muscat, Qatar, Yeman and Oden total in excess of 100,000 metric tons. In general, the product mix found in the preceding countries can also be extended to cover these countries as well.

It can be seen from the nature and extent of steel imports to the Near and Middle East that this area absorbs a substantial amount of world steel exports. The demand for steel is constantly increasing, thus the area will continue to import steel in large quantities for several years to come. However, expansion plans, particularly those of India, Pakistan, Turkey and Egypt will cut steel imports to a considerable degree, but will by no means eliminate them. These plans are ambitious and may not be realized fully, but there will be a partial realization of them in the next five years. The extent of this will depend on the amount of capital obtained and the number of trained personnel available. These two factors are essential and will be of paramount importance in solving other problems.

Africa

Of the many countries which make up the continent of Africa, only the Republic of South Africa can be considered a major steel producing nation. However, many of the African countries are significant producers of iron ore and manganese ore. Thus, on balance, the continent as a unit must be recognized as a net importer of steel and a net exporter of iron ore and manganese ore.

The Republic of South Africa is in many ways in an enviable position with respect to iron and steel production and trade. Iron ore and manganese ore production have grown steadily in South Africa since 1950, as have exports of these basic materials. Iron ore production has increased from about 1.170 million gross tons in 1950 to over 2 million tons in 1956 and by 1963 was in excess of 4.3 million gross tons. Further, since 1956 the country's exports of iron ore have increased even more rapidly than production, rising from 77,000 tons in 1956 to over 600,000 tons in 1962. In terms of manganese ore, the Republic of South Africa is one of the world's largest producers as indicated by the 1.4 million gross tons of production in 1962. Exports of this material have fluctuated between 400,000 and 900,000 tons in recent years, often depending on the relation of home consumption to production.

The Republic of South Africa has also steadily increased domestic coal production since 1950 as well as maintaining a significant level of coal exports. Thus, the country has abundant and rich basic steelmaking

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steel output in Nigeria increased from [illegible] metric tons to 200,000 metric tons over the period, although between 1980 and 1981 a temporary down-trend occurred and output declined from 180,000 metric tons to 170,000 metric tons. Nigeria's share of the market during the period stayed within the range of 1 to 1 per cent of the total for Latin America.

Nigeria has one principal steel mill which, at the present time, is an integrated plant with coke ovens, a blast furnace, three Thomas converters, an electric furnace, a blooming mill, a structural mill and a merchant and pipe mill. By until the present time the plant has not produced at the rate should and this is due in part to a number of circumstances including relatively low grade ore, coal high in ash and the ability to use only a small amount of scrap. In fact a hand sheet mill was installed to produce some flat rolled products.

While the next few years a proposed expansion of the plant which has been approved will be undertaken with the help of a $50 million loan from the World Bank. The total cost of expansion and modernization is approximately twice this figure, or $[illegible] million. There will be no actual increase in basic facilities but rather an improvement in the raw materials as a result of which much more steel should be produced. The proposed project includes a coal washing plant, stockpiling plant, an oxygen plant, some coking pits and a blooming and slabbing mill, as well as a [illegible] inch Steckle bar mill. This should increase production substantially so that by 1987 output should be in the neighborhood of [illegible],000 metric tons. This will allow the company to increase the shipments of finished products from approximately 125,000 metric tons to 400,000 metric tons.

It is estimated that the market in Columbia will increase from a level of 207,000 metric tons in 1963 to an average of 400,000 metric tons in 1970. Further expansion is planned by that time so that the steel facilities will be able to keep pace with demand.

Over the period Mexico increased its crude steel output by 542,000 metric tons so that production in 1963 totaled slightly more than 2 million metric tons. Despite this increase, the share of total output accounted for by Mexico declined from 31 per cent to 29 per cent.

There are a number of companies that plan further additions in the future. One of these is Fundadora Steel Company which at present has a capacity for a little less than 500,000 metric tons. Its plans call for a third blast furnace which will be rated at 400,000 to 500,000 metric tons per year, two additional open hearth furnaces with a capacity of 250,000 tons per year, a tandem cold mill, all of which will cost $40,000,000. This is under contruction now, and with the addition of $10,000,000 more several years hence, the company will raise its ingot capacity to 1,000,000 tons per year.

Another steel producer in Latin America, Venezuela, has had a remarkable growth in production since 1960 when output was 47,000 metric tons. In 1963 it stood at 250,000 metric tons. The rapid expansion in steel output was due to the construction of a fully integrated plant, The Orinoco Steel Company, which is located on the Orinoco River close to the iron ore deposits. The mill has ten electric smelting furnaces for iron reduction and four open hearths with a rated capacity of 700,000 metric tons. This capacity has not been realized due to the fact that there is not an adequate supply of electric power to enable the smelting furnaces to produce enough iron for consumption in the open hearth. The plant produces seamless pipe, structural steel and bars.

There is an abundance of rich ore in Venesuela and once sufficient power is available, steel production should increase to twice the 1963 figure.

Through the period under consideration, Peru has contributed about 1 per cent of the total Latin American steel output. Its production increased from 59,000 metric tons in 1960 to 76,000 metric tons in 1963. The plant for the country is located at Chimbote. Its facilities consist of two low shaft electric reduction furnaces for smelting iron and two electric arc furnaces, each with a 25 ton capacity. The company has recently completed two 20 ton oxygen converters and has plans for a 4 strand continuous billet casting machine, as well as a 550 ton blast furnace.

The smallest steel producer in Latin America is Uruguay which witnessed a downturn in production from 1960 to 1963 from 10,000 metric tons to 7,000 metric tons.

Chile expanded its production of crude steel from 450,000 metric tons in 1960 to 528,000 metric tons in 1962 and dropped off slightly in 1963 with production of 521,000 metric tons. Thus its share of the market fell from 10 percent to 8 percent over the period under consideration.

Chile increased its iron ore production to 8 million tons during 1963, which was approximately 16 percent higher than the previous year. Of this 8 million ton, 7 million tons were exported, which represented an increase of 17 percent over 1962.

Latin American Steel Imports

It has been argued that in most Latin American steel producing countries a domestic steel industry was planned as a substitute for a limited range of imported steel products. Efforts toward domestic production are generally concentrated in the product categories which are most in demand, thus affording the advantage of large-scale production. Products of limited market demand are usually supplied through the continued reliance on imports. The major Latin American steel imports, including those of steel-producing and non-steel producing nations, totaled [illegible] metric tons. The major sources of this tonnage were Japan, which accounted for [illegible] tons, followed by Belgium-Luxembourg with [illegible] tons, West Germany with [illegible], the United States with 305,800 tons and the United Kingdom with [illegible] tons. The major sources of Latin American steel imports are listed in the following table:

Major Sources of Latin American Steel Imports 1962
(thousands of metric tons)

Country of Origin	Quantity
Belgium-Luxembourg	372.0
Canada	149.4
West Germany	154.0
France	[illegible]
Italy	149.4
Japan	175.0
U.S.S.R.	200.5
United Kingdom	301.6
United States	305.8

Source: United Nations, Economic Commission for Europe, Statistics on World Trade in Steel 1962, New York: United Nations Publication, 1963, pp. 7, 9, 11, 13, 17, 19, 31, 33, 35.

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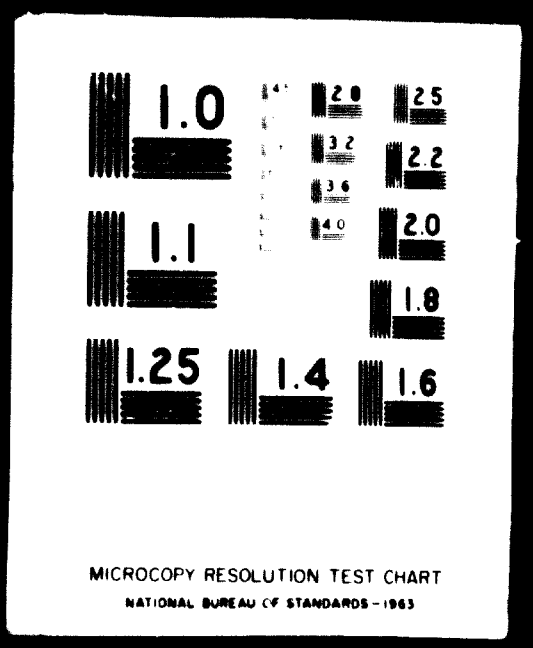
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS - 1963

raw materials, a fact which explains in part the rapidly increasing position of the nation in the world steel market. In order to appreciate fully the rising importance of South Africa as a steelmaking country, production figures for selected years are given below:

Year	Production in Millions of Net Tons
1950	.9
1954	1.5
1956	1.8
1958	2.0
1959	2.1
1960	2.4
1961	2.7
1962	3.1
1963	3.3

Source: American Iron and Steel Institute

Ghana and Guinea: Between the two countries about 50,000 tons of African imports are accounted for. Aside from 13,000 tons of sections imported by Ghana from Belgium Luxembourg, the product mix is diversified into small amounts of several products.

Liberia: Steel mill product imports by Liberia in 1962 totalled about 70,000 gross tons of which the vast majority were from the United States and Belgium Luxembourg. About one half the total was centered in rails and associated railroad products.

Libya: Libya, which in 1962 was the leading African importer of steel products, accounted for nearly 192,000 gross tons of imports. Of this total, about 160,000 tons were made up of tube, pipe and fittings, most of which were produced in Germany, Italy and the Netherlands.

Malagasy Republic: This country imported about 31,000 tons of finished products in 1962, most of which was produced in France. Other than 13,000 tons of light and heavy sections, the product mix of this country's imports were well diversified.

Morocco: Morocco, one of the leading African importers of steel products, accounted for approximately 135,000 gross tons of imports in 1962. Close to 105,000 tons of this total was imported from France the large part of which was in flat rolled products, tinplate and heavy and light sections.

Mozambique. Total imports into this nation in 1962 were approximately 47,000 gross tons. About one half of the total was in heavy and light steel sections, principally produced by the Republic of South Africa. About 15 percent of imports were in rail and associated steel mill products.

Sudan: Sudan imported 92,200 gross tons of steel products in 1962 and thus was one of the larger steel product importers in that year. More than half of this amount was produced in the United Kingdom and Belgium-Luxembourg. The overall product mix of imports was well diversified except for some concentration in structural sections.

Togo: Approximately 53,000 tons of steel imports were absorbed by steel consumers in this nation in 1962. The source of virtually all these imports was France and other than 24,000 tons of sections the product mix was well diversified.

Other African nations accounted for an additional 300,000 tons of imports on which detailed information is not readily available. However, it is evident that Africa as a whole and in particular some of its individual nations represent rapidly growing steel consuming centers. Further, since the Republic of South Africa is the only large steel producing nation, the other African nations will continue to depend upon Europe and the steel producing nations of the world for their steel needs. Even if domestic production in these countries begins to move ahead, there will still be dependence for semi-finished products as well as

some categories of finished products for, on the whole, steel demand in these countries is not yet sufficient to warrant large scale and diversified operations.

In many ways the possibility of establishing or expanding a basic steel industry in any of the African countries where demand and markets are sufficient to warrant it, would involve problems common to most developing economies. Iron ore is readily available but coal supplies are limited and then there are the more acute problems associated with obtaining capital, developing power and transportation and training a skilled production and technical labor force.

The United Nations estimated in 1959 that steel consumption in Africa, exclusive of the Republic of South Africa, would be approximately 4 million gross tons by 1972-1975. If this expectation is realized, it will require a large tonnage of imports for the present plans concerning future production in these countries will not provide an adequate supply of steel to meet their demand. For most African countries it would seem that the approach to building a steel industry should take the course from a non-integrated mill importing semi-finished steel to a semi-integrated mill which could melt scrap. For the present, because of the problems discussed above, this would seem to be a practically attainable goal.

CONCLUSION

There has been a pronounced trend among the developing countries that have attained political independence since the war to establish themselves with a degree of economic independence. Virtually all of these nations were in a colonial status before their independence and, consequently, had no problem with foreign exchange since this was taken care of by the mother country. Having attained independence, this has become a problem for most of them because they are basically agricultural economies or suppliers of raw materials. One of the first steps in the drive to develop economic self-sufficiency has been the establishment of some type of steel industry, albeit, a very limited one. Thus we find that since the end of World War II, when there were 32 countries producing steel, this number has grown to 71 by 1965.

Most developing economies require construction materials and thus we find that a number of small bar mills have been constructed for the purpose of rolling concrete re-inforcing bar. Such was the case in the Philippines, Singapore and Puerto Rico. Very often these mills were second hand mills and thus purchased for relatively small amounts of capital. In addition, the recent developments in direct reduction and continuous casting have given further impetus to the establishment and growth of small steel plants. It has been estimated that a new mill consisting of an electric furnace, a continuous casting machine and a small bar mill can be purchased for $5 million to 6 million. If the electric furnace and bar mill are second hand units, the entire cost of the plant can be reduced to something less than $2 million and in one

notable case even less than $1 million. However, such an investment, although it does establish a steelmaking operation and in so doing limits the dependence of the country in question on the outside world, to a small degree, usually provides one product or at the most, two or three, namely, reinforcing bars and small structural shapes. As a result the country is still dependent on outside sources for other steel products such as sheets, rails, heavy structurals, pipe and tin plate.

The problem which confronts the developing countries is the choice between importing steel and the establishment of a domestic industry. Traditional economics would in most instances favor imports for quite often steel can be imported more cheaply than it can be manufactured.

This has been particularly true in the past few years with a build-up of steel capacity among the industrial nations of the world. Exports have increased tremendously and this has put pressure on the price of steel so that it is now possible to purchase steel on the world market at a lower price than it sells for domestically within the industrialized countries.

In most instances where a new steel industry is established it is accompanied by a protective tariff and thus the consumers must pay a higher price for the product than they would if it were imported. This is a much agitated question at the present time in several countries that are planning to install steel capacity. In one instance the domestic price from the new plant will be $100 per ton while the same steel product can be imported currently at $78 per ton.

The principal of comparative advantage in international trade would dictate that steel be imported. However, the problem of foreign exchange comes up to plague the developing countries and they feel it is better to pay more for a product in their own currency than less for it in the currency of another nation i.e. dollars or pounds, if the foreign currency is relatively scarce. Thus a new dimension has been added. Further, the desire to use one's own raw materials to make finished steel products rather than exporting these materials and then buying back the steel products has a strong appeal. Finally the hope that in the future the country can become an exporter of steel and thus generate more foreign exchange has been almost irresistable.

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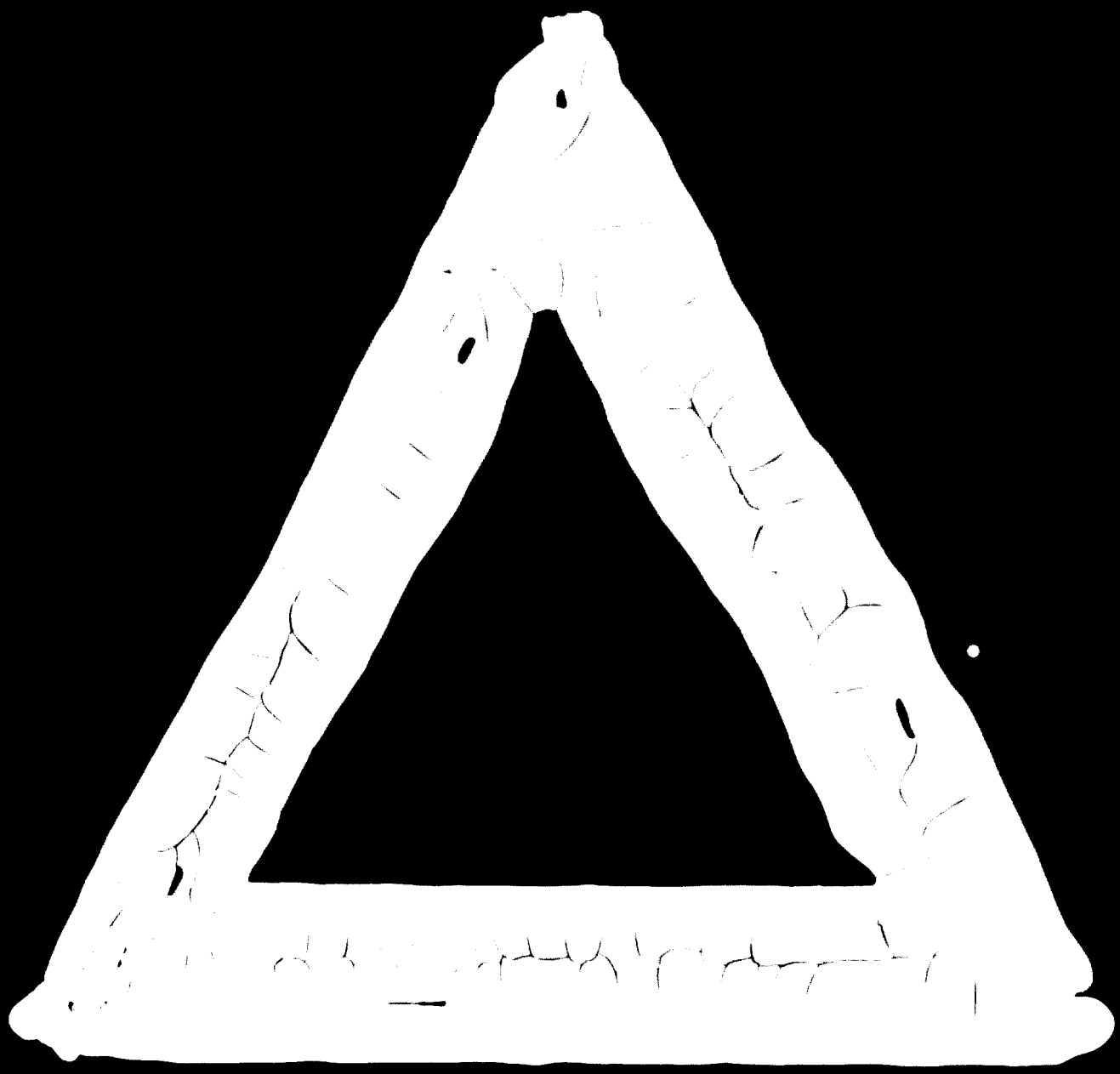

In terms of steel shipment, the major product groups produced in South Africa in recent years have been the following:

Product	Shipments (thousands of metric tons) 1960	1961	1962
Blooms and Billets	115.2	79.9	93.5
Bars and Rods	297.7	317.0	348.2
Angles, Channels, etc.	163.9	168.7	199.4
Hoop and Strip	63.3	70.8	103.2
Plates	227.8	281.0	354.8
Sheet - uncoated	179.8	183.8	240.1
Sheet - galvanized	156.3	121.3	154.1
Heavy Rails	92.6	128.7	115.3

Source: British Iron and Steel Federation

Aside from the above mentioned products produced by the Republic of South Africa, the country also produces lesser amounts of wire rod, tinplate, blackplate and most other standard steel products. Yet, in spite of the noteworthy domestic production, both in terms of quantity and product mix, South Africa still imports sizeable amounts of steel. However, in recent years, these imports have declined significantly as indicated by the fact that total imports in 1958 were near 350,000 tons and in 1964, they dropped to approximately 125,000 tons. In

some products such as rails where domestic production has increased sharply. Imports have diminished to almost nothing.

While imports to the Republic of South Africa have declined significantly in recent years, exports from that country have increased significantly. In 1958 total exports were about 69,000 gross tons, by 1960 they rose to 150,000 and in 1962 they had further increased to over 330,000 gross tons. Of this total for 1962, about 120,000 tons found a market in other African countries and 134,000 tons were remarketed in Western Europe.

The Republic of South Africa with its growing production will become more of a force in providing for the steel needs of the African continent, as well as caring for its own increasing requirements. Further, it is self-contained in regard to raw materials. The announced plans for expansion will bring its crude steel production capacity to approximately 4 million tons by the end of 1965. The facilities to be installed include two new blast furnaces, an electric steel melting furnace, a continuous casting machine, a hot strip and cold strip mill and a structural mill.

The Federation of Rhodesia and Nyasaland had a production in 1961, 1962 and 1963 of 90,000 ingot tons. It also produced a significant tonnage of iron ore. In 1962 and 1963 output was 609,000 tons and 591,000 tons, respectively. As is the case with a number of developing countries, Rhodesia and Nyasaland imported a wide range of steel products. The figure has been in excess of 100,000 metric tons per year for the last several years and consists predominantly of flat rolled products, rail and pipe.

Algeria

Algeria presently produces a limited tonnage of bars and rods. However, plans have been formulated and work has been started on a considerable expansion of the domestic steel industry. They call for an integrated plant capable of producing 500,000 tons of ingots which will consist of a blast furnace using Algerian ore, as little coke as possible and injection of oil or gas at the tuyeres.

The initial plans calls for the export of ingots and semi-finished products in large amounts, possibly up to 300,000 tons. There is a substantial steel market in Algeria and it is hoped that in a relatively short time rolling mills will be constructed to produce 350,000 tons of finished product for the domestic market.

The plant was started with French capital and all the fundamental steps of site preparation, foundations, etc., have been completed. Additional financing has been obtained from the Russians and it is hoped that the blast furnace may be in operation by mid 1966. The schedule calls for the operation of steel producing units and some rolling mills by the end of 1967.

Unlike many of the developing countries which have installed rolling mills first in order to produce finished products as quickly as possible, Algeria has begun with the production of basic iron and steel. Thus the export of semi-finished products becomes a necessity if any revenue is to be obtained from the plant at an early date.

A number of the other African countries are at present significant factors as suppliers of iron ore for the industrialised countries. Their importance will grow in the next few years in view of the fact that substantial reserves have been recently discovered within their borders. In 1963 the continent of Africa produced in excess of 15 million gross tons of ore. With the exception of the Republic of South Africa which used most of its 4.3 million tons for its domestic industry, the ore was exported. A summary of ore production by the African nations in recent years indicates the growing importance of that continent as a supplier of high grade iron ore.

(thousands of gross tons)

	1963	1962	1961	1960
Algeria	1,752	2,029	2,822	3,384
Angola	787	742	799	649
Republic of Guinea	689	689	533	764
Liberia	3,563	3,550	3,200	3,003
Mauritania	1,300	984	295	...
Morocco	1,004	1,131	1,439	1,552
Rhodesia and Nyasaland	591	609	382	156
Sierra Leone	1,772	1,983	1,668	1,447
Sudan	...	20	...	3
Tunisia	787	749	836	1,017
Republic of South Africa	4,321	4,263	3,898	3,023
Total	15,246	16,749	15,872	14,998

Source: American Iron and Steel Institute

In general African iron ore is of high quality with an average iron content no less than 52 percent and with much of the ore ranging between 60 and 65 percent.

1964 was a year of considerable increase in African iron ore exports. Liberia produced approximately 8 million tons in one ore development alone. Another was responsible for 2 million tons of production. Thus the total for the country when all four producing units are consider was in excess of 10 million tons. Future plans for these deposits indicate that by 1970 production for the country will be in excess of 15 million tons. This will include several million tons of pelletized ore.

The ore reserves of Mauritania have been developed within the last few years by a combination of Europen steel companies. In 1963 production was 1.3 million tons and in 1964 was in excess of 4 million tons.

Without doubt the most spectacular development in African iron ore is in Gabon where reserves of 1,250,000,000 tons of high grade iron ore, 64 percent iron, have been discovered. This vast supply of ore could well be augmented by further discoveries in the next few years and thus this country will have a prime place as an ore supplier for the world. Gabon also has abundant supplies of rich manganese ore which ranges up to 52 percent.

At present African ore is shipped to Europe, North America and to some extent, Japan. It would seem that its primary market at least in the next decade will be Europe. However, a substantial tonnage is being used in the United States at the present time and this could well increase. In 1963 the United States imported approximately 1.5 million tons of ore from Liberia and this increased in 1964 to more than 3.5 million tons.

While it is necessary to recognize the increasing importance of Africa as a source of raw materials and the Republic of South Africa as a major steel producing nation, the continent will continue to be a sizeable importer of finished steel products for a number of years to come. In 1962 African steel imports were about 1,800,000 gross tons. In terms of individual countries of origin, the following constituted the major sources of supply:

Belgium-Luxembourg	246,000 gross tons
Germany	140,000 gross tons
France	615,000 gross tons
Italy	77,000 gross tons
Japan	114,000 gross tons
Republic of South Africa	120,000 gross tons
United Kingdom	253,000 gross tons
United States of America	71,800 gross tons

In terms of product mix, there were four major products which were imported into the African countries. These were rails and rail products which accounted for over 380,000 tons, flat rolled products including tinplate which were more than 440,000 tons, pipe, tube and fittings which were approximately 290,000 tons, and light and heavy sections which represented close to 325,000 tons of imports. Thus the great part of Africa's imports of finished steel products is concentrated in the more or less basic steel products which are so essential to economic development.

In order to present a more detailed picture of the steel imports in Africa, an analysis of individual countries and their imports follows:

Algeria: In 1962, Algeria imported about 145,000 gross tons of finished steel products. Of this total, 142,000 tons were from France, in the following major product mix: 35,000 tons of light and heavy sections, 57,000 tons of pipe, tube and fittings and about 23,300 tons of flat rolled products, which include tinplate. Other imports include lesser amounts of rails, rail products, wire and wire rods and some semi-finished products.

Angola: Total imports by Angola were about 31,000 gross tons of steel products, spread out over several products with little concentration in any one.

British East Africa: British East Africa imported a total of 123,300 tons of finished steel products in 1962 which represents a sizeable part

of total African imports. Much of this total is concentrated in flat rolled products, sections and railroad products and rails.

Central African Customs Union: Total steel imports by the nation in 1962 were about 30,000 gross tons. The great part of it, 27,000 tons, was imported from France and consisted primarily of 11,000 tons of sections, 8,400 tons of flat rolled products and 4,000 tons of rails and rail products.

Congo (Leopoldville): The Congo imported 50,900 tons of steel products in 1962, about 20,000 tons were in flat rolled products and in excess of 12,000 tons in light and heavy sections.

Ethiopia: Steel imports by Ethiopia totalled 18,400 tons of which the major component was 8,000 tons of sheet steel brought in from Japan.

Federation of Nigeria: The Federation of Nigeria imported nearly 130,000 gross tons of steel products in 1962, and thus rates as one of the larger importing nations in Africa. Of this total, close to 50,000 tons were in flat rolled products, including 28,000 tons of sheet from Japan. Other major product imports were 34,000 tons of rails and rail equipment.

Federation of Rhodesia and Nyasaland: This country imported slightly more than 100,000 gross tons of steel products in 1962. Of this total, about 80 percent was imported from the Republic of South Africa. In terms of products, 37,300 tons were in rail products, 35,000 in flat tolled and 14,000 in heavy and light sections.