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PRESENT STATUS AND FUTURE OF THE IRON AND STEEL INDUSTRY OF AFRICAN COUNTRIES [1]

by

R. Robson,
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[1] The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. The document is presented as submitted, without re-editing.

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Introduction

The general situation on the African continent in regard to the development of the iron and steel industry is that apart from South Africa and the U.A.R. where however conditions are not typical of Africa generally, such development is of very recent date and few countries are engaged in iron and steel production. More interest attaches therefore to current plans for establishing the industry and to the prospects for its future development having regard to the market situation and to the availability of the factors of production.

Statistical information in many countries is often not available in the detail required while in addition current figures are not always representative of normal conditions in view of the difficulties which some countries have experienced following independence. Estimates based on visits to the countries concerned and on reports by consultants have been made where necessary in order to present a reasonably comprehensive and accurate account of the situation.

(a) Consumption and demand

(i) As may be seen from the table overleaf, current consumption of iron and steel products per head in African countries is at a very low level; in half the countries concerned it amounts to less than 10 kg as compared with 250 - 300 kg in developed countries. Moreover since most African countries are very small, only nine out of the forty concerned having a population in excess of ten million, it follows that even where consumption per head is at a relatively high level total consumption is still very low. Only in seven countries does it exceed 100 thousand tons per annum (annex I).

While the primary reason for the low per caput consumption is the low level of income, a subsidiary reason is often the virtual absence of an engineering industry which in developed countries normally accounts for two thirds of total iron and steel consumption. In no African country at the present time does the consumption of iron and steel in engineering uses quite equal that in construction uses and in the majority of countries it is less than one quarter of the latter. This means of course, as shown in the table, heavy imports of machinery and transport equipment.

Consumption of iron and steel in African countries

	Consumption per head in kg			Imports of engineering goods per head	Population (million) 1965
	Construction	Engineering	Total		
N.African sub-region (1963-5)					
Algeria	10.8	4.5	15.3	11.6	11.9
Libya	87.3	2.0	89.3	69.9	1.6
Morocco	7.6	5.2	12.8	6.0	13.3
Tunisia	17.3	4.5	21.8	14.7	4.4
Sudan	5.2	0.2	5.4	6.4	13.5
U.A.R.	13.3	7.3	20.6	8.0	29.6
W.African sub-region (1962-4)					
Mauritania	3.8	1.1	4.9	8.6	1.1
Senegal	19.6	4.2	23.8	4.0	3.5
Mali	1.5	0.3	1.8	1.4	3.9
Ivory Coast	7.3	2.9	10.2	10.8	3.8
Upper Volta	1.0	0.2	1.2	1.3	4.9
Dahomey	3.4	0.6	4.0	2.5	2.4
Niger	0.8	0.2	1.0	1.4	3.3
Gambia	4.1	0.8	4.8	5.4	0.5
Guinea	3.7	1.0	4.7	2.9	3.5
Sierra Leone	8.2	2.3	10.5	10.4	2.3
Liberia	15.9	6.8	22.7	32.8	1.1
Ghana	9.4	9.2	18.6	10.3	7.7
Togo	3.5	0.7	4.2	4.3	1.6
Nigeria	4.1	1.4	5.5	2.8	57.5
E. African sub-region (1961-3)					
Rhodesia,Zambia,Malawi	14.8	6.4	21.2	14.1	4.3/3.7/3.9
Ethiopia	1.4	0.2	1.6	1.0	22.6
Somalia	1.4	0.4	1.8	1.3	2.5
Rwanda	2.4	0.6	m3.0	2.3	3.1
Burundi	2.4	0.4	2.8	2.5	3.2
Mozambique	2.0	0.7	2.7	5.4	7.0
Tanzania	2.7	0.5	3.2	2.6	10.5
Madagascar	4.9	1.2	6.1	2.8	6.4
Uganda	1.3	0.3	1.6	2.2	7.6
Kenya	10.6	3.8	14.4	3.8	9.4
Mauritius	20.1	3.6	23.7	20.0	0.7
C.African sub-region (1963-4)					
Congo (Dem. Rep.)	..	..	4.2	2.0	15.6
Cameroon	..	..	6.1	6.2	5.2
Congo (Brazza.)					0.8
C.A.R.	..	..	2.2	4.8	1.4
Chad	..	..	1.7	2.0	3.3
Gabon	..	..	23.2	87.0	0.5
South Africa (1964)	..	..	137	43	17.9

Source: The Development of the Engineering Industry in East Africa E/C.N.14/INR/90 Aug.19
" " " " " " in West Africa E/CN.14/INR/126 Sept19
" " " " " " in North " E/CN. May 19

(ii) The relative importance of the engineering industry in most African countries also largely accounts for differences in the pattern of consumption as compared with that in developed countries. This follows from the fact that the engineering industry is mainly a consumer of flat products and of castings and forgings while the construction industry uses mainly sections, the position being roughly for engineering 51% flats, 32% sections, 17% castings (incl. iron castings) and forgings, and for construction 18% flats, 77% sections and 5% castings. In African countries therefore the expected demand for castings and forgings is low except for example in the U.A.R. where the engineering industries are more developed and consumption is equal to about 10% of that of rolled steel compared with 20 - 25% in developed countries. In the case of flat products the low proportion of consumption which should follow from the low engineering demand is offset by the substantial use of flat products in construction uses namely galvanized sheet especially for roofing purposes and the welding of tubes. As shown in the table below, while there is therefore not a great deal of difference between the percentage of flat products used in the various African sub-regions and that in developed countries such as the U.K. there is a very great difference in its content, cold-reduced sheet for example accounting for half U.K. consumption of sheet and strip but for only sixth of West African consumption. In countries such as Ghana where galvanized sheet is not used to any great extent partly as a result of competition from aluminium it accounts for only 2% of all steel consumption - in contrast to Sierra Leone where the percentage is 45 - and a more normal pattern results, flat products accounting for one third of steel consumption and cold reduced sheet for one third of sheet consumption.

In the section category the proportion of heavy sections consumed is negligible in African countries and of medium sections rather small in spite of the relatively large construction of railways. On the other hand the consumption of bar and rod is very high in proportion reflecting once more the low level of engineering requirements for which buildings are normally constructed from sections and also the low level of wages which encourages the relatively labour intensive ferro-concrete construction.

Patterns of iron and steel consumption

	U.K.	W.African sub-region	E.African sub-region	N.African sub-region
Rolled Steel	100	100	100	100
Heavy sections	12	1	2	3
Medium sections + rails	20	10	12	13
Light sections: bar	6	23	20	30
other	3	5	8	5
Wire rod	3	10	6	5
Seamless tube	4	2	2	2+3 (petroleum)
Plate	16	5	5	9
Sheet: hot rolled	5	-	11	2
for welded tube	5	17	8	7+7 (petroleum)
cold reduced	18	6	(	9
galvanized	2	16	(26	2
tinned	6	5	(	3
Castings + forgings incl. iron castings	22		1	7

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by

R. Robson,
Economic Commission for Africa

SUMMARY

The paper gives an account of the present and prospective levels of consumption of iron and steel products in the various African countries and corresponding to this the present and prospective level of production. The development of the industry is discussed in terms of the availability of the factors of production, of the effects on trade, of the level of costs, and of the investment involved. Finally, some account is given of the organization of the industry and of the impact of Government policies.

The current consumption per head of iron and steel products in African countries is very low amounting to less than 10 kg in half the forty countries concerned as compared with 250-300 kg in developed countries. This is a consequence of the low level of income and also of the virtual absence of an engineering industry in many cases. As most of the countries are also small from a population point of view only seven of them have a consumption of iron and steel in excess of 100,000 tons per annum at the present time.

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* This is a summary of a paper issued under the same title as ID/WG.14/8.

1/ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. The document is presented as submitted by the author, without re-editing.

The pattern of consumption is very different from that in developed countries, consumption of galvanized sheet and hot-rolled sheet or tubes being important while, because of the low engineering demand, the consumption of cold-reduced sheet and of castings is proportionally very low. Ferro-concrete construction is favoured as compared with sections. In Libya, Algeria and Nigeria the petroleum industry is a major user of steel in the form of pipe-lines.

Forecasts of demand may be made by relating increases in consumption per head to those in Gross Domestic Product (GDP) and then allowing for indirect imports. Such forecasts suggest an annual increase in iron and steel consumption in the region of about 10% with engineering uses increasing about half as fast again as construction uses.

Because of the great economies of scale in integrated iron and steel production, such plants only exist in the larger markets, i.e. South Africa, the United Arab Republic and, more recently, Algeria and Tunisia, but other activities such as scrap melting and rolling of bar and light sections and tube welding, galvanizing and wire drawing are carried on in several countries. With regard to future developments, while the larger countries may continue with little disadvantage to plan their industry on a national basis, it is important that all the smaller countries and some of the larger ones without suitable raw materials should co-operate in the development of the industry so that plants of an economic size supplying a multi-national market and based on the best available raw materials should be established. For this purpose the Economic Commission for Africa has made projections for the establishment by 1980 of sub-regional plants in the East, West and Central sub-regions and for some degree of specialization and integration in the North sub-region. Such plants apart from heavy-plate seamless tubes and sections would supply about 90% of requirements.

With regard to factors of production Africa is, in general, well placed as far as supplies of iron ore are concerned. This is particularly so in West Africa where the deposits rank among the most important in the world although they are not located in the largest markets, i.e. Nigeria and Ghana. In the other sub-regions supplies, although less plentiful, are certainly sufficient to ensure fifty years of expansion of the iron and steel industry. Coking coal is not generally available. Apart from South Africa and Rhodesia which have extensive

high-grade deposits coking coal is only found in the United Arab Republic and Algeria in rather limited quantities and with somewhat inferior coking properties. Petroleum and hydroelectric potential, however, are both great. Labour and management present difficulties in establishing an iron and steel works because of the expense of training labour and of employing highly-paid expatriate technicians and management for a number of years.

The proposed development of the industry would have a profound impact on the present trading pattern which consists of importing about 95% of requirements - apart from South Africa - mainly from the former colonial powers. By 1980 only about 25% of requirements would be imported from outside Africa and there would be a considerable intra-African trade.

As far as costs of production are concerned and given equal capacity an iron and steel works established at a suitable location in Africa would have an advantage in access to iron ore which, however, would be partly offset unless it had access also to cheap coking coal as in Southern Africa. Its advantage in regard to cheap labour would be entirely offset initially in the East, West and Central African sub-regions by the need to employ highly-paid expatriate staff. The main disadvantage is the higher cost of erecting the works which, even at a coastal site, would be some 25% above European levels. These disadvantages are considerably increased if small capacity plants are erected. With reasonable capacity, however, steel can be produced at prices competitive with imports and give a reasonable return on capital.

Total investment needed to provide 75% of African iron and steel requirements by 1980 would be of the order of $4,000 million. If, instead of large sub-regional works, a number of smaller works were established the capital cost per ton would be about one third higher but total production and investment would be reduced.

Iron and steel plants in most African countries will either be operated by established firms in developed countries or will be State enterprises operated initially under a management contract.

Councils of Ministers and other institutions are being established in Africa to promote industrial co-operation on a sub-regional basis.

In addition to the factors of low engineering demand and high temporary demand for galvanized sheet and welded tube a third factor may be distinguished namely the use of steel in special products. The outstanding example of this is the petroleum industry in Libya, Algeria and Nigeria accounting in the first of these for about two thirds of total steel consumption. Less striking examples are the use of tinplate in Ivory Coast and Morocco accounting for about 15% of consumption compared with 6% in the U.K.

(iii) The consumption of iron and steel products at any time evidently depends in the first place on the level of economic activity and in particular on investment since capital formation in the form of machinery, buildings and transport equipment is a major user of steel accounting under normal conditions of growth for up to two thirds of total iron and steel consumption. In the second place consumption depends on the extent to which this capital formation is met by the domestic engineering industry or from imports.

In recent years the development of iron and steel consumption in Africa has on the whole been irregular, independence bringing in many cases a decline in investment which for example in the Congo and Algeria has been so great that consumption is still only half of what it was in pre-independence days. Consumpti in North Africa was affected from 1960-1963 in Central Africa from 1957 - to date, and in East Africa from 1957-1961 (Annexe 2). It is not always possible therefore to specify particular years as being "normal" in regard to consumption and instead it is necessary to relate consumption in any year, chosen as a base year from which to make projections, to the level of the Gross Domestic Product and investment in that year. In so doing total consumption i.e. direct plus indirect must be taken. If then a forecast is available of the rate of growth of G.D.P. it is possible to forecast total iron and steel consumption - a simple method based on regression analysis for African countries suggests that consumption per head increases one and a half times[1/] as rapidly as G.D.P. per head. after which either as a result of a separate engineering study or in other ways an estimate must be made of the proportion of demand likely to be met by imports of machinery, etc.

This procedure has been carried out in three of the African sub-regions and the results are shown in the following table. It will be noted that engineering uses are expected to increase much more rapidly than construction uses.

[1/] The development of Engineering Industries in Africa op.cit. P16

Projections of iron + steel demand '000

	N. Africa	W. Africa	E. Africa
Present total demand (total)	1947	994	
Imports of engineering goods (metal equiv.) (indirect)	682	394	326
Demand for iron and steel (direct)	1266	602	498
of which: construction	880	414	371
engineering	386	188	127
Total demand 1980 (total)	6403	3300	2360
Import of engineering goods (metal equiv.) (indirect)	1921	990	760
Demand for iron and steel (direct)	4482	2310	1600
of which: construction	2611	1100	780
engineering	1871	1210	820

Reference: As for page 4.

(b) Production

(i) Of the factors limiting the establishment of an iron and steel industry in developing countries the size of the available market is usually the most critical because of economies of scale in the various processes involved. Broadly speaking, costs of producing steel on an integrated basis, i.e. from iron ore begin to rise more sharply below an annual output of about 200,000 tons per annum and even at this level access to cheap raw material is necessary to make a domestic industry competitive with the large plants operating in industrialized countries. For the hot rolling of flat products the minimum scale of economic operation even on low capacity reversing mills is still higher.

The production of steel by melting scrap can be carried on economically at lower levels say 10 - 20,000 tons per annum but at this level also requires access to cheap material, i.e. scrap to be competitive. Similarly, the simpler produots such as reinforcing bar and light sections can be rolled at not too high cost especially when capital is scarce at an annual output as low as about 25,000 tons per annum on less mechanised mills and may be competitive given access to cheap steel. While such processes as galvanizing sheet or drawing wire or welding of strip into tubes can be conducted on the relatively small scale of about 10,000 tons per annum.

It follows that except in South Africa and the U.A.R., and more recently in Algeria and Tunisia where integrated works have been established, production has so far been limited to theses smaller scale operations.

(ii) Outside of North Africa and South Africa where markets are largeenough to permit if necessary the establishment of the iron and steel industry on a national basis development depends in large measures on the possibility of co-operation between the relatively small countries concerned with the object of establishing large scale integrated plants supplying a sub-regional market and using the best available materials within the sub-region. The intention is to supply from domestic sources all products for which the market is sufficiently large for economic production to be undertaken. In practice this excludes heavy sections, heavy plate and seamless tube for which the market tends to be limited and a proportion ranging from about 10% to 25% of other products which may be specialties - in total about one quarter of the market. Proposals on these

lines have been put forward by the Economic Commission for Africa and are included in the following account of present capacity, current plans and projections.

These proposals are in course of being checked against the results obtained by input - output analysis which has been used to obtain a consistent programme of economic development in each sub-region. Since steel demand is almost entirely intermediate this is ultimately the best method of forecasting it. So far the method has produced higher estimates of future demand than those referred to in (a) (iii) i.e. giving in fact in the case of West Africa a demand in 1975 equal to that projected for 1980.

(iii) North Africa[1/]

Morocco

The basic iron and steel industry of Morocco consists at present only of wire drawing works of 4,000 tons per annum capacity; there is no integrated iron and steel making or steel rolling either with or without scrap melting. There are numerous foundries and forges with an annual capacity of 5,000 tons.

In the 1960-1964 plan it was proposed to establish a scrap melting and rolling mill at a cost of about $300 per annual ton with an output of 60,000 tons mainly of reinforcing bars. Local scrap was considered adequate, as is the market, but this plan was abandoned. Other proposals in the 1960-1964 plan which did not materialize, included the establishment of a ferro-manganese plant with an annual output for export of 20,000 tons and at a capital cost of $ 240 per ton. Current supplies of local ore of metallurgical quality were estimated at 200,000 tons per annum but reserves are steadily declining. Another proposal was to manufacture welded and galvanized steel tubes for the local market. The capacity of the plant was to be 7,000 tons and the capital cost $ 170 per ton. The 1970 Government projections include the steel tube plant and an extension of wire drawing capacity to 5,000 tons per annum.

In the 1965/67 plan, three alternative steel developments were outlined. First a rolling mill based on imported billets. Secondly a rolling mill based on scrap melting. And thirdly, an integrated iron and steel plant.

Source: E.C.A. Study on Industrial Economic Cooperation for the North African sub-region - June 1968

The location proposed for either of the first two was Casablanca which offers both the largest market for finished steel and the largest supply of scrap. Location for the integrated works was at Nador on the coast near the ore fields and near the port (Melilla) for iron ore exports. It is understood that a decision has now been taken in favour of the integrated iron and steel plant with a capacity of 250,000 tons of iron per annum and 160,000 tons of steel.

Algeria

The basic iron and steel industry of Algeria consists at present of a scrap melting unit at Oran, producing reinforcing bar and with a melting capacity of 30,000 tons per annum and a rolling capacity of 40,000 tons per annum. In addition, there is a welded tube plant of about 25,000 tons capacity based on imported semis and wire drawing capacity 45,000 tons. Production in recent years has been at about one third capacity.

The capacity of the iron and steel foundries is around 15,000 tons per annum, and about 4,000 tons were produced in 1963.

The main current development is the erection of the integrated iron and steel works at El Hadur on the coast near Annaba (Bone). This will have a capacity of between 3 - 400,000 tons of flat products. Construction started in April 1966 and under the present programme the blast furnaces should be completed end 1968, the steel plant end 1969 and the hot strip mill in 1970. It is probable that galvanized sheet, tin plate and welded tubes will also be made. It is estimated that 2,700 km of oil tubing will be required.

The projections of E.C.A. suggest that by 1980 there will be a market for a 600,000 tons capacity flat products mill within the Maghreb countries, i.e. Morocco, Algeria, Libya and Tunisia. In addition there will be a market within Algeria alone for about 160,000 tons of bar and light sections.

Tunisia

The Manzel Bourgiba integrated iron and steel works came into production in 1966 when 36,000 tons of finished steel were produced. Production in 1967 is estimated at 70,000 tons. The capacity of the blast furnace is 150,000 tons per annum and of the rolling mills 100,000 tons per annum.

The projections of E.C.A. suggest that this capacity will be adequate up to about 1975. In addition however E.C.A. has proposed a medium section plant in Tunisia to supply the needs of the Maghreb countries.

Foundry production in 1966 amounted to about 4,000 tons. With the construction of the arsenal foundry, capacity 2.8 thousand tons iron and 3.8 thousand tons steel and with extensions elsewhere, capacity by the end of 1968 is expected to reach 12 thousand tons. Wire drawing including screws and bolts and tube welding is envisaged at about 8,000 and 6,000 tons annual respectively.

Libya

There is a small production of reinforcing bar based on rails and billets, and scrap melting will be started when scrap availabilities are large enough.

U.A.R.

Iron and steel making facilities in the U.A.R. are relatively advanced. The main unit is the integrated works at Helwan with a finished steel capacity of 200,000 tons per annum producing flat products as well as light and medium sections. Other units include three semi-integrated plants with a capacity of 180,000 tons per annum in round bars. It is proposed to expand the capacity of the Helwan works to 1.5 million tons per annum ingot steel and to include a strip mill already under construction with an ultimate capacity of 700,000 tons per annum finished products. The plant will use oxygen steel making and continuous casting. The establishment of a second integrated plant is contemplated at Aswan with a capacity of 400,000 tons per annum in round bars and comprising electric reduction, oxygen steel making, continuous casting and a fully continuous bar mill. A wide plate mill of 200,000 tons per annum capacity and based on slabs from Helwan is under study and might form the nucleous of a third integrated works. The existing semi-integrated plant intend to double their capacity and one of them will specialize in special alloy steels.

Thes proposed capacities are in accordance with E.C.A. projections except that the proposed plate mill will require the whole sub-regional market. E.C.A. has also proposed that wire rod should be manufactured in the U.A.R. on a continuous mill basis to supply the whole sub-regional market.

(iv) South Africa

Crude steel production is currently 1966-1967 at the level of 3.5 million ingot tons per annum of wh ch 3.2 million is produced by ISCOR. Current development plans envisage an increase in ISCOR's capacity to 5.2 million tons by 1970.

The rate of increase of steel production in recent years has averaged 9 per cent per annum compared with 4½ per cent in the world as a hole and 11 per cent in all developing countries. ISCOR has postponed the construction of a third works until 1970. Such a works would probably be located on the coast nearer to coal supplies and also to the coal and ore deposits of Swaziland and would be in a favourable position to export - assembly costs being only about half of those obtaining in Europe.

(v) West Africa

The only steel making facilities in West Africa at present are those of the scrap melting plants in Nigeria near Enugu and in Ghana at Tema the former with a capacity of 10,000 tons and current output of about 9,000 tons per annum and the latter with a capacity of about 30,000 tons and a current output of about 12,000 tons. Several plans exist for the future development of the industry stemming in part from the sub-regional proposals of the United Nations Economic Commission for Africa. These proposals were based initially on the fact that the sub-regional market was only large enough to permit of one integrated plant of an economic size and calculations established that the lowest overall cost location of this plant would be at lower Buchanan in Liberia. A plant with a capacity of 350,000 tons of bar and light sections was initially proposed based on the market in 1970. The proposals were subsequently modified to accept the erections in due course of an integrated plant in the interior and of a number of re-rolling plants at other centres. As a result of subsequent discussions it appeared that the following developments were contemplated in the various West African States. First an integrated plant in Nigeria. This has been the subject of numerous investigations by a variety of experts with the object of using the somewhat inferior ore and coal reserves of the country. Secondly and in due course an integrated plant at Gouina in Mali based on Senegal ore and hydro-electric power from the Senegal river. Thirdly a number of projects more or less linked with the proposed integrated plant in Liberia as a supplier of billets and stabs namely a scrap melting and billet using works in the Ivory Coast with an initial capacity of 25,000 tons

per annum, a re-rolling works in Guinea with an initial capacity of 70,000 tons per annum rising to 200,000 when electric furnace reduction of the Conakry ores is undertaken, a scrap melting and re-rolling works in Sierra Leone and in Senegal and an extension of the existing re-rolling facilities at Tema. The integrated plant in Liberia would have a 1975 capacity of about 1 million tons a figure also suggested by input-output analysis for the sub-region.[1/]

An independent survey commissioned by UNIDO (April, 1968) related to an integrated plant in Liberia, producing bars and light sections only and excluding the Nigerian market with an estimated market in 1980 of 240,000 tons.

(vi) East Africa[2/]

The iron and steel making facilities available in the East African sub-region consist of the integrated works at Que Que in Rhodesia and the scrap melting works at Jinja in Uganda, and at Akaki near Addis Ababa, Ethiopia.

The Que Que works consist of blast furnaces with an annual capacity of about 250,000 tons per annum and open hearth steel furnaces with a capacity of 150,000 tons per annum. The rolling mills have a capacity of about 160,000 tons per annum including 45,000 tons of light sections as well as medium sections, rails, billets, etc. The immediate extension plans of the Rhodesian Iron and Steel Company include increased capacity in both iron and steel making. Ore preparation will be improved to increase the output of the existing blast furnaces and with a new 23 feet diameter furnace output will increase to 820,000 tons per annum very largely for export. Steel making improvements will increase the output of the open hearth furnaces to about 200,000 tons per annum.

The Ethiopian iron and steel works at Akaki has an ingot steel capacity of 12,000 tons per annum and a rolling capacity of 18,000 tons per annum. The bulk of the production is sold as reinforcing bar. Present production is about

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1/ Summarized in Industrial Development in West Africa: An integrated analysis E.C.A. 1968.

2/ Sources: The iron and Steel Industry in Africa E/CN.14/AS/III/23 December 1965 Development of the Steel Industry in East and Central Africa E/CN.14/INR/17 July 1965. The Liberian Steel Project UNIDO February 1967. Iron and Steel and first stage of transformation E/CN.14/INR72

6,000 tons per annum and scrap availability within Ethiopia is sufficient for a production of 9,000 tons per annum.

The East African steel works at Jinja has a steel making capacity and a rolling capacity of 24,000 tons per annum. The main product is reinforcing bar although angles and flat bar are also produced. Current production is about 6,000 tons finished steel per annum. Scrap for the works is collected from Uganda, Kenya and Tanzania and is ample for present rates of production, but could not sustain the maximum output. Expansion plans include the production of baling strip and tubing.

Other steel activities in the sub-region include the manufacture of tubes, drawing of wire and galvanizing of sheets. Steel pipes (present output about 3,000 tons per annum) and conduit tubing are produced in Zambia and seamless tubes (about 9,000 tons per annum) in Rhodesia. Wire rod and wire are produced at Que Que where the steel plant has a capacity of about 25,000 tons per annum. Wire is also produced at Akaki. Galvanizing and corrugating plants with a capacity of about 50,000 tons per annum are in operation in East Africa and new galvanizing lines are projected for Ethiopia and Uganda.

A plan for the co-ordinated development of the iron and steel industry in the sub-region was presented at the Conference on the Harmonization of Industrial Development Programme in East Africa held in Lusaka from 26 October to 6 November 1965. As in the case of West Africa calculations were made to show the advantages of various sites for locating an integrated works but in this case it was not assumed a priori that a single plant serving the whole sub-region would necessarily be the best solution on purely economic grounds although in fact it turned out to be so. Calculations were made for a number of possibilities including a single integrated works, an integrated works and re-rolling works, two integrated works, and three integrated works and re-rolling works.

The proposal for three integrated works, although the least profitable, was recommended mainly to secure a balanced development of the sub-region. In detail this proposal suggested by 1980 the erection of three integrated works each of about half a million tons annual capacity at Que Que (Rhodesia), Tororo (Uganda) and Lusaka or vicinity (Zambia), together with a large rerolling mill (1/4 million tons capacity) at Dar-es-Salaam and smaller re-rolling works of about 50,000 tons annual capacity at Addis Ababa and in Madagascar. The profitable

operation of the re-rolling works would require them to be supplied with billets from the proposed integrated works at pieces somewhat below market levels.

In view of the limited market until 1980 and the fact that the Zambia/Tanzanie railway would have to be constructed it was proposed that the construction of the Lusaka works should be postponed until 1975, but that the expansion of the Que Que works and the erection of the Toronto works could begin immediately. In the meantime it is understood that the Zambia Government has had studies made of the responsibility of using local ore and coal in a direct reduction process to supply bar and light sections estimated at about 70,000 tons per annum.

All these proposals are to be submitted to the Council of Ministers which it was agreed should be established to co-ordinate industrial development in the sub-region.

(v) Central Africa

The only steel making facilities at present operating in Central Africa are those of the electric scrap melting plant at Jadotville with a capacity of 8,000 tons per annum and a current output of 7,000 tons per annum. Studies have been made on the possibility of manufacturing reinforcing bars and light sections for the UDEAC countries and for the Congo but neither scheme has been proceeded with. In the meantime, the ECA mission for economic co-operation in Central Africa July 1965 has advocated the desirability of setting up an iron and steel industry on a sub-regional basis which would require a detailed survey of the relative advantages of various possible sites for locating an integrated works on the lines of those already carried out in the East and West African sub-regions.

From the point of view of raw materials and manufacturing costs a coastal site in Gabon is likely to be favoured while from the point of view of the market the Congo which is expected to account for about two-thirds of the total steel consumption in the sub-region has a predominant interest. In the longer term the major iron and steel development is likely to be based on the Mekambo iron ore deposits at Gabon or on the Sangha deposits of Congo (Brazzaville). It is possible to envisage an integrated iron and steel works of 400,000 tons per annum, crude steel capacity based on conventional rolling mills. It should

be noted that production costs in Gabon were estimated in the ECA study to be not significantly greater than in Liberia (between 6 and 7 per cent) which seems likely to be the site of the first integrated iron and steel plant in West Africa.

Given the time required to construct the railway and develop the mine full scale production would hardly be possible at Ovendo before 1975. In the meantime, it is possible that the Inga Hydroelectric scheme will have been initiated which would permit the development of an integrated iron and steel plant in the Congo based on electric smelting. To begin with this could be based on the high quality ore available from Mauritania, and later Gabon or Congo (Brazzaville). On a sub-regional view such works might have a capacity of 100000 tons per annum supplying bar and rod and sections for which the market by 1970 would be sufficient while the Gabon plant would produce flat steel products. A study of iron and steel development in the sub-region has recently been made under joint Italian Congo auspices but details are not yet available.

(c) Factors of production[1/]

The factors of production considered are iron ore, coal, petroleum, electric power and labour.

As far as iron ore is concerned, new deposits are frequently revealed as prospecting proceeds. Numerous iron ore deposits are available in Africa but since an integrated works producing a minimum of half a million tons of iron a year and using therefore 1 million tons of ore is under consideration interest only attaches to those deposits which individually or in close proximity can sustain such a works. Assuming that in view of the heavy social and industrial investment associated with a steel works a life of 30 to 50 years is required, this means a deposit of the order of 30 to 50 millions tons or the equivalent in adjacent deposits. This assumes that the deposit is high grade which for practical purposes may be taken as containing over 50 per cent of iron. Lower grade deposits under50 per cent can usually be beneficiated to raise their iron content but this is expensive and the naturally enriched deposits will almost invariably provide the basis for a steel industry. In

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1/ Sources: The world market for iron ore E.C.E. Steel Working Paper Aug.1966.
The Iron Ore resources of Africa E.C.A. 1964.
Raw materials in Africa for iron and steel manufacture E.C.A.1963
Explanatory Note: Coal Map of Africa E.C.A.-A.S.G.A. 1966
Situation Trends and Prospects of Electric Power Supply in Africa E/CN.14/Ep.2

most cases these higher grade deposits occur as pockets of enrichment in very much larger masses of lower grade iron bearing rock of perhaps 30 to 40 per cent iron content. It should also be recognized, however, that not only may new deposits be discovered since it is scarcely worth while to prospect in areas remote from transport facilities but also that in regard to existing deposits it has not been worth while in many cases to go the considerable experse of proving the reserves by numerous borings. In many cases therefore the actual reserves may be very much greater than those at present stated. In particular large new deposits in extension of the Gabon deposits have recently been found in Congo (Brazzaville), the Sukulu deposits in Uganda are now estimated at about 45 millions tons, new deposits amounting to between 20-80 million tons have been estimated in the Eritrea province of Ethiopia and the deposits in Mali have been reassessed. Most African countries have in fact adequate iron ore resources to sustain an integrated iron and steel industry although their relative advantages for this purpose, depend also on the quality of the reserves, i.e. iron content and presence of impurities as well as on their accessibility. The major deposits in West and North Africa are connected by railway to the coast for export purposes, but others e.g. in Zambia, Gabon, Tanzania and Libya are not linked to transport facilities at present. Details are given in annex 4.

Fuel especially coal is much less generally available (annex 4). Coking coal is required for the operation of the classical blast furnace system and in only available in large quantities in South Africa and Rhodesia, and in smaller quantities in the Sinai Peninsula. Non-coking coal is more generally available - large quantities in Southern Africa and substantial deposits over 100 million tons in Morocoo, Algeria, Tanzania, Nigeria and Katanga. Charcoal made from timber is a substitute for coking coal within limits in the blast furnace system and adequate supplies exist for example in East Africa where coal supplies are both limited and inaccessible. Oil and natural gas can be used to reduce coke requirements by injection into the blast furnace or by direct reduction of iron ore and are available in large quantities in North Africa, West Africa and Central Africa. Hydroelectric possibilities in Africa are probably unparalleled and could be used for electric smelting especially in the Central African and East African sub-regions.

Labour

The absence of trained labour and management is a difficulty to be overcome in establishing the iron and steel industry in most African countries. It is however by no means insuperable since it involves only the making of arrangements to train labour and to obtain expatriate management for a time. Where the finance for establishing a works is forthcoming the finance for training will also be available and in fact one procedure is to treat this as a capital cost amounting to about 12 per cent[1/] of the cost of the plant. Expatriate management can also be obtained either through equity participation or on contract but it is also an extra cost because of the high salaries required. It may be estimated that the management and technical grades involved amounting to about 10 per cent of the labour force would account for one third of labour costs at normal domestic differentials but to one half if recruited from abroad.

(d) Trade

With the exception of South Africa which supplies about three quarters of its own requirements, the U.A.R. supplying about 40 per cent and more recently Tunisia about 60 per cent, African countries are almost entirely dependent for their supplies upon foreign imports local production in the East, West and Central African regions supplying less than 5 per cent of the market.

The trade is still largely in hands of the former colonial powers, who are also however the principal steel exporting countries in general, although their share has fallen rapidly during the last five years (Annex 4); Belgium Britain and France accounting for 45 per cent of the total in 1965 compared with 72 per cent in 1950 while Italy increased her share from 3 per cent to 15 per cent, Japan from 4 per cent to 14 per cent, Germany from 6 per cent to 9 per cent and other countries in total from 15 per cent to 17 per cent including Eastern Europe from 4 per cent to 8 per cent.

Exports in 1965 were 50 per cent higher than in 1960 but excluding South Africa where they rose nearly five fold and Libya nearly four fold the increase was only 5 per cent. Excluding in addition Algeria and the Democratic Republic of the Congo, where there was a heavy fall, trade increased by about one third. While the current re-distribution of trade among exporting countries will probably continue the realisation of the ECA projections given above would reduce dependence on non-African sources about 25 per cent of the total market. This would leave non-African trade at about its present level but the creation of multinational plants in each sub-region would induce a considerable intra-African trade.

1/ Iron and Steel and first stage of transformation op.cit.

(e) Costs, prices and efficiency

Dividing costs of production in the usual way into assembly costs, being the cost of bringing raw materials to the site, and processing costs at the site of manufacture a suitably located iron and steel works in a developing country will have an advantage over a developed country in regard to assembly costs. This arises primarily in regard to iron ore since most Western European works depend on imported ore and incur therefore transport charges of the order of $ 5 per ton over and above the normal f.o.b. prices of $ 10 approximately Since moreover this $10 includes a fairly high margin of profit which might be reduced in favour of a local works the general position is that iron ore may be available to such a works e.g. Liberia at about half the price at which it is available to a European works or at less than this if the local works is located inland near a suitable deposit e.g. Rhodesia. If in addition the works is located near deposits of good coking coal as in Rhodesia and South Africa coke will be available also at about half the price at which it is available in Western Europe. In general however iron and steel works in Africa will have to import coke or coking coal although in this case they should not be at much disadvantage with regard to European works since both are increasingly likely to import from the U.S.A.

Processing costs on the other hand will normally be higher than in Europe partly because of inherent differences and partly because the average sized works established in Africa is likely to be smaller than the average European works and so higher cost. Dealing first with economies of scale a works of 400 thousand tons annual capacity will have a capital cost per annual ton about one third higher than one of 1½ million tons and one of 200 thousand one third higher than one of 400 thousand. Other processing costs are less strongly affected e.g. for labour corresponding figures are 10 per cent and 25 per cent and for material usage about 2 per cent and 15 per cent. The inherent differences are first that because of transport and higher installation charges it costs from one quarter to one third more per annual ton to erect a plant in a developing country while in addition there will usually be housing and amenity charges. The wage factor has already been referred to, Its incidence on costs however is determined by productivity and in this regard a new African Steel works will be competing with average age European works which in consequence of rapid technological change will have only half the labour productivity of a new works.

Productivity comparisons are however very difficult to make and in Africa it has been generally assumed that productivity at a new works will be about the same as at an average European works in which case apart from economies of scale an African works should have an advantage.

In total the various projections already referred to all indicate a substantial return, on capital in a New African works selling at imported prices. Examples are as follows:

Proposed[1] Liberian steel works: Capacity 350,000 tons per annum. Costs of production of bar and rod including 10 per cent return on capital $ 100 per ton compared with import price c.i.f. of about $ 120.

Proposed[2] East African integrated works of 1,400 thousand tons capacity sections and flat products.

Cost of production including 25 per cent return on capital about one third below imported prices. Gross return on capital 33 - 40 per cent. The position is obviously very strongly influenced by economies of scale.

(f) Investments[3]

The investment necessary to provide by 1980 three quarters of domestic requirements of iron and steel in Africa excluding the Republic of South Africa is of the order of $ 2000 million. This magnitude is only meaningful however when related to the total investment required to promote industrial development on the continent and to the sources of finance.

Taking as an example the West African sub-region, where E.C.A. has completed a study of integrated industrial development, capital formation in iron and steel required by 1980 will lie between $ 600 and $ 800 million while that in manufacturing industry will amount to $ 7,200 million and in all activities including agriculture and services to $ 31,000 million. It is further estimated that about 41 per cent of this can be met by domestic savings, 5 per cent by grants in aid, 36 per cent by Government borrowing, 6 per cent by

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1/ Iron and steel and first stage of transformation op.cit.

2/ Development of the Steel Industry in East and Central Africa op.cit.

3/ Industrial Development in West Africa: An integrated analysis E.C.A., April 1968 op.cit.

foreign equity capital, and 12 per cent by private borrowing including suppliers credits. Only about 10 per cent of Govt. borrowing will be for manufacturing industry which will take however about half the remaining external finance. Payments are balanced by assuming a nominal rate of interest on Government borrowing and 6 per cent on private.

The iron and steel demands are small in relation to these magnitudes and their financing depends more on priorities than on the actual amount involved. In some countries moreover, notably in Liberia, reliance on external finance is hardly necessary.

If the target of meeting three quarters of domestic requirements is not satisfied by creating a few large scale enterprises and instead a larger number of small enterprises are established then total investment will be considerably increased as e.g. two integrated plants making cold reduced sheet with an annual output of 500 thousand tons will cost 20% more than one of 1 million tons and five of 200 thousand tons 60 per cent more. Exceptions to this are small plants based on scrap melting or on electric reduction.

There may well be a case however within the order of priorities as a whole for reducing total investment in iron and steel production without affecting economies of scale by limiting the field to be covered e.g. to sections only. This would mean in the East, West and Central African sub-regions agreement on one plant only but would reduce total investment to little more than one third of that contemplated above.

(g,h) Organizational structure and Government action

The difficulties in the way of securing finance, management and where necessary protection against competition have tended to make large scale iron and steel enterprises in Africa State enterprises.

Examples are ISCOR in South Africa, RISCO in its early stages in Rhodesia and the existing works in Tunisia, Algeria and the U.A.R. In some cases this has been national policy and has included relatively small scale works as in Ghana while in other countries e.g. Nigeria, Uganda, Ethiopia and the smaller

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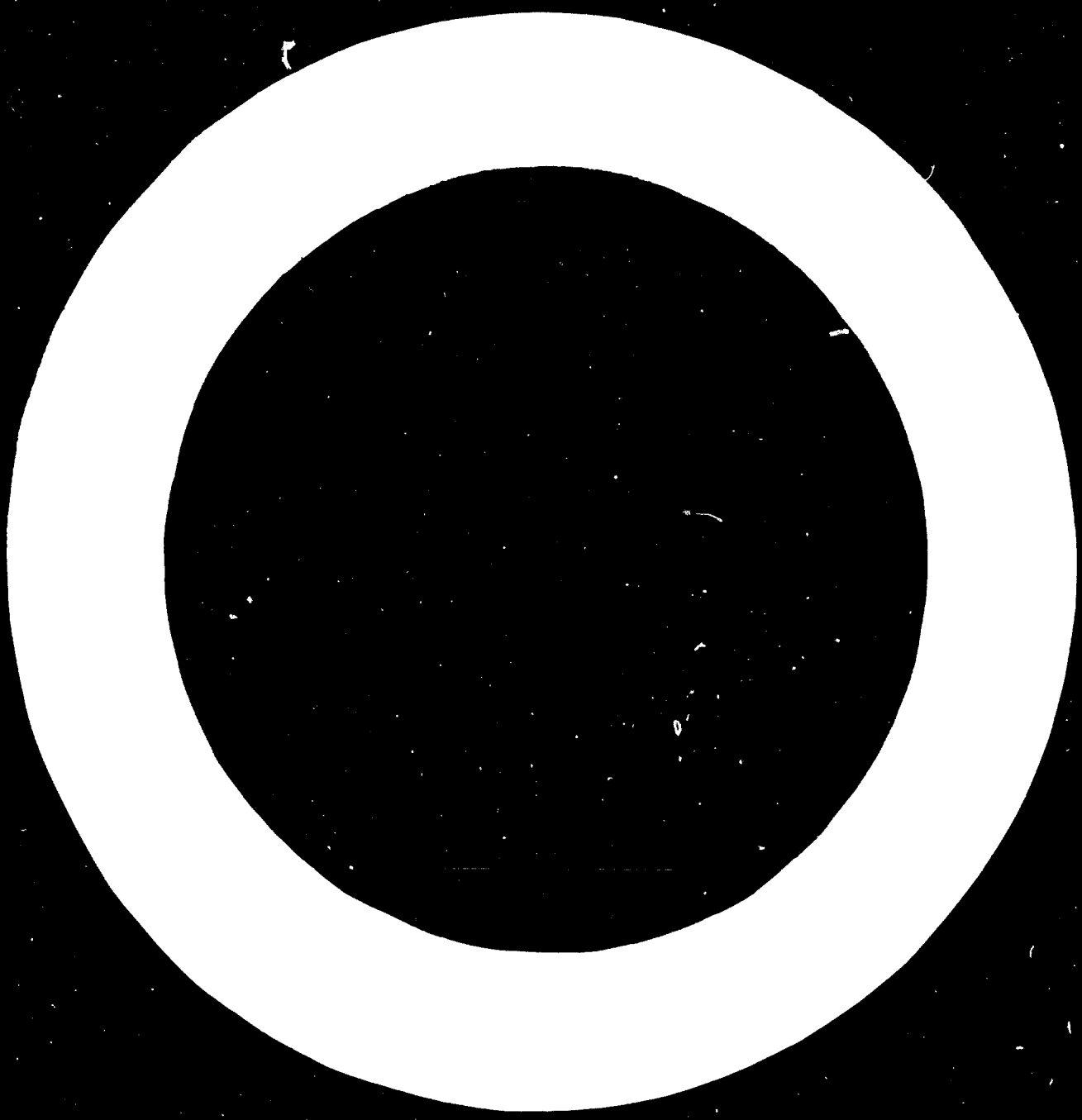
1/ Economic Cooperation in Africa E/CN.14/UNCTAD 11/4 December 1967

enterprises in South Africa private enterprise has been encouraged. There is nevertheless even in countries devoted to private enterprise an increasing tendency towards active state participation in the iron and steel industry for reasons of planning and sharing of profits. The new large scale iron and steel works projected for African countries are likely therefore to be either state enterprises operating where necessary under a management contract with a foreign organisation as at present in China or private enterprises i.e. branches of foreign steel firms with a substantial state interest.

The plants projected are in most cases multi-national plants requiring therefore agreement among a number of countries as to the location of the plant and the removal of restrictions on trade in the products concerned. For this purpose institutions[1/] have been or are being established in Africa in the form of Councils of Ministers with their appropriate industrial and trade committees at which these problems can be discussed.

1/ Economic Cooperation in Africa E/CN.14/UNCTAD 11/4 December 1967



ANNEX I

Annual consumption of iron and steel in African countries

'000 tons

	Direct	Indirect	Total
North African sub-region (1964)			
United Arab Republic	588.0	225.1	813.1
Algeria	173.7	135.1	315.2
Morocco	162.0	76.5	246.8
Libya	139.2	111.7	254.9
Tunisia	93.9	66.9	163.0
Sudan	74.1	72.4	148.1
West African sub-region (1963)			
Nigeria	288.6	156.4	454.0
Ghana	130.4	75.5	210.9
Senegal	45.5	13.3	59.3
Ivory Coast	39.6	42.2	82.3
Sierra Leone	26.6	27.0	54.4
Liberia	19.7	32.8	55.5
Guinea	15.0	9.7	24.9
Dahomey	8.7	5.5	14.3
Mali	7.8	6.4	14.2
Togo	6.8	6.8	13.7
Upper Volta	5.1	6.1	11.3
Mauritania	3.4	6.0	9.4
Niger	2.9	4.4	7.4
Gambia	1.5	1.6	3.1
East African sub-region (1962)			
Rhodesia/Zambia/Malawi	217.0	150.0	374.0
Kenya	118.0	32.9	156.2
Madagascar	34.3	15.1	50.0
Ethiopia	32.3	22.1	55.0
Tanzania	28.5	25.0	55.3
Mozambique	21.9	35.5	59.1
Mauritius	16.2	14.0	30.6
Uganda	11.2	15.1	26.5
Rwanda	7.7	6.9	14.9
Burundi	7.1	6.5	13.8
Somalia	3.6	2.9	6.6
Central African sub-region (1963-1964)			
Congo (Dem. Rep.)	63	31	94
Cameroun	30.6	31.2	61.8
Congo (Brazzaville)	12.5	14.2	26.7
C.A.R.	3.1	6.6	9.7
Chad	5.1	6.2	11.3
Gabon	10.6	18.5	29.1
Republic of South Africa (1964)	2400	750	3150

ANNEX II

Consumption of Iron and Steel

'000 tons

	North Africa[a]	West Africa[a]	Central Africa[a]	East Africa[a]	Southern Africa
1953	450	220	180	170	1,300
1954	560	230	190	240	1,390
1955	670	250	230	350	1,510
1956	680	250	230	350	1,550
1957	620	320	240	370	1,760
1958	820	310	150	320	1,650
1959	920	370	130	290	1,300
1960	1,130	360	90	380	1,620
1961	1,100	450	110	420	1,810
1962	1,050	500	110	430	1,770
1963	1,070	530	140	430	1,980
1964-1965	1,230	590	510	510	2,400

Average annual consumption (1901-1963) in the North African sub-region amounted to just over 1 million tons, of which the U.A.R. accounted for 420,000 tons. Domestic supplies during this period averaged 300,000 tons.

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[a] North Africa: Algeria, Libya, Morocco, Sudan, Tunisia and the U.A.R.

West Africa: Dahomey, Gambia, Ghana, Guinea, Ivory Coast, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo and Upper Volta.

Central Africa: Angola, Cameroon, Central African Republic, Chad, Congo (Brazzaville), (Congo (Dem. Rep.) and Gabon.

East Africa: Burundi, Comoro, Ethiopia, French Somaliland, Kenya, Madagascar, Malawi, Mozambique, Reunion, Rhodesia, Seychelles, Somalia, Tanzania, Uganda and Zambia.

ANNEX III

Present and projected capacity of iron and steel plants in Africa

('000 tons)

	Present capacity	Current plans	Projections ECA (1980)
North Africa			
Morocco:			
Wire drawing	4.0	5.0	20.0
Welded tube	-	7.0	15.0
Integrated bar and light sections	-	180.0	200.0
Tin plate	-	-	50.0
Castings	8.0	8.0	45.0
Algeria:			
Wire drawing	8.0	8.0	30.0
Welded tube	25.0	25.0	25.0
Integrated sheet and strip	-	400.0 in course of erection	600.0 to supply Maghreb
Scrap melting and bar	40.0	..	160.0
Petroleum pipe lines	-	..	60.0
Castings	18.0	18.0	50.0
Tunisia:			
Wire	100.0	8.0	8.0
Welded tube	-	6.0	8.0
Iron castings		12.0	25.0
Integrated bar and light section		..	120.0
medium section		-	160.0

	Present capacity	Current plans	Projections ECA (1980)
Libya:			
Wire	-	..	10.0
Welded tube and pipe lines	-	..	110.0
Iron castings	-	..	25.0
Scrap melting and bar	5.0	..	60.0
United Arab Republic:			
Wire	9.0	..	60.0
Welded tube	20.0	..	60.0
Iron castings	75.0	..	150.0
Scrap melting and bar	180.0	360.0	360.0
Integrated sections	115.0	350.0	700.0
Integrated plate	50.0	500.0 + 200.0 later	700.0
Sudan:			
Wire			6.0
Welded tube			8.0
Iron castings			15.0
Scrap melting and bar			100.0

(in tons)

	Present capacity	Current plans	Projections ECA (1980)
West Africa[a]			
Ghana:			
Scrap melting and bar	30,000	..	450,000 tons
Nigeria:			
Scrap melting and bar	10,000	Integrated plant, no details	650,000-1,000,000 tons
Ivory Coast:	-	25,000-60,000 scrap melting	120,000 melting and re-rolling
Mali:	-	..	100,000 integrated
Guinea:	-	70,000 tons re-rolling-200,000 integrated	..
Senegal:	-	25,000 scrap melting	70,000 melting and re-rolling
Sierra Leone:	-	-	400-500,000 "
Liberia:	-	-	240,000 (1980) bars and light tubes[b]
East Afrioa[c]			1,000-1,200,000 integrated
Uganda	Scrap melting 24,000	..	500,000 integrated
Zambia	-	..	600,000 integrated
Tanzania	-	..	250,000 re-rolling
Ethiopia	18,000 tons scrap melting	..	50,000 re-rolling
Rhodesia	Integrated 160,000 tons	200,000 tons	600,000
Madagascar			50,000 re-rolling

[a] Industrial Development in West Africa, an Integrated Analysis - ECA, 1980.

[b] The Liberian Steel Project - UNIDO, Feb. 1968.

[c] Development of the Steel Industry in East and Central Africa (E/CN.14/INR/87/Add.2).

ANNEX IV

Principal iron ore deposits already investigated

West & Central Africa

Country	Location	Approximate per cent composition					Initial estimate of reserves (m. tons)	Accessibility to transport	Remarks
		Fe	SiO_2	Al_2O_3	S	P			
Dahomey	North (Niger frontier)	c.50				0.6–1%	80	None	
Gabon	Mekambo	65	1.7	2.1		0.15	Over 200	(Railways to	
	Tchibanga	43	27	4–5	0.05	0.18	(	(coast proposed	
		53–60	12	5	0.06	0.35	(150	but not built	
Ghana	Shiene	30–52	16–37	0.5–0.7		0.1–0.7	Over 100	At present remote	
Guinea	Conakry	53	1.6–2.3	10	0.11	0.06	1000	Rly.to coast avail.	Contains Cr. and Ni
	Simandou	Thought similar to Nimba (below)					Large(over 200)	Could be connected to Liberian Rly.	
Ivory Coast	Monogaga	50					100	40 km. from port	
	(Other districts with considerable deposits of low grade ore)								
Liberia	Boni Hills	64–65	1–5		0.03	0.06	50	(Railways to	Many other rich deposits
	Bong	65–66	4–8	low	0.03	0.035	150	(coast available	
	Mano River	56–58	2–5	5–7	0.07	0.05	100		
	Nimba	65–66	4	0.9	0.04	0.04	Over 200		
Mauritania	Ft. Gouraud	65–66	3.3	0.8	0.06	0.03	110	Rly.to coast avail.	probably exist
Niger	Say (nr. Niamey)	43–55				0.6–1	225	On river	
Nigeria	Agbaja	47–51	6–9	8–10	0.1	0.7–1.3	270	Nr. river transport	
	Enugu	35–45	14–16	9–10		0.6–0.8	110	Nr. railway	$1\frac{1}{2}\%TiO_2$
Senegal	Extreme S.E.(Kenieba)	50–60	5–7			0.06–0.18	100	At present remote	
Sierra Leone	Marampa	63–64	6.3	1.5	0.005	0.009	50–100	Rly.to coast avail.	
	Tonkolili	56	2.5	8.5	0.06	0.07	Large (over 100)	Could be conn. to Rlys.from Marampa	
Togo	Banjeli	50	high				20	None	
Congo(Brazza)	Zanaga	42–45					100	None	
	(Large deposits extensions of Gabon)								
Congo(Dem.R.)	Ituri	65					10–50		
	(Also in Katanga and Kasai)								

North Africa	Name	Reserves	Composition %				Location
			Fe	SiO_2	Al_2O	S P	
Algeria	Ouenza	130	54	4	0.6	.04 .002	On railway 190 kms. from coast.
	Djebilet	765	58	5	4	- 0.8	No railway 500-700 kms. from coast.
Morocco	Uixan Setolaza[a/]	50	62	1.2	0.1	- .01	On railway 25 kms. from Melilla.
Tunisia	Djerissa	32	54	4	0.8	- .02	On railway 200 kms. from coast (Tunis).
	Tamara	12	52	4	3.7	- 0.1	On railway near coast.
	Djebel Ank	30	53	8	5.8	- 1.0	Near railway.
Libya	Shatti valley	700	48				No railway 600 kms. from coast.
United Arab Republic	Aswan	20	47	14		0.6-1.0	800 kms. by rail to Helwan.
	Baharya	180	50	10			300 kms by rail to Helwan.
	Red Sea	80	43				

a/ Reserves now estimated at only 25 million tons after 1970.

East and South Africa	Name	Reserves (mln. tons)	Composition % Fe	SiO_2	P	Location
Sudan	Sofia	12	60	..	..	Near coast.
	Abu Tulu	36	61	..	..	100 km. from railway.
Somalia		250	50	..	..	No rail. 250 km. from coast.
Uganda	Kigezi	30	65	..	..	120 km. from railway.
	Tororo	45	62	1.1	2.6	Near rail.
	Bukusu	20	(TiO_2) 10-20			
Tanzania	Liganga	45	50 Al_2O_3 10 TiO_2 13			On projected rail extension from Massia.
	Manyoro	68	30			On Lake Tanganyika.
Zambia	Nambala	250	57			120 km. from rail.
	Sanje	30	57-65			50 km. from rail.
	Shimwyoka	17	69			
	Pamba	42	55			
Rhodesia	Buhwa	100	60			Near rail.
	Que Que	30	60			Near steel works.
	Manisi	over 30	60			80 km. from rail.
Madagascar	Bekisopa	10	60			Close to railway.
	Moramanga	40	46	1.5-2.1	$N_2S_2T_2$	Close to railway.
Mozambique	Machedua	50	50 TiO_2 18			On river.
Swaziland	Ngwenya	40	62			Railway in course of construction.
	Gege	55	40			
South Africa	Thabazimbi	100	54-58			240 km. by rail to Pretoria.
	Postmasburg	200	61			700 km. by rail to Johannesburg.
	Large deposit under 50% Fe.					

Principal Coal Deposits

	Name	Reserves	Composition
North Africa:			
Morocco	Jerada	120	Anthrasite 4-5% ash 5-6% volatile.
Algeria	Bechar	30	22-25% volatile poor coking.
	Abadla	over 1,000	31-32% volatile poor coking.
United Arab Republic	Sinai	40	poor coking.
East and South Africa:			
Rhodesia	Wankie	820	13% ash good coking.
	Sabi	large	good coking.
Bechuanaland	Morapule	300	non-coking.
Madagascar	Sakoa	60	25% volatile 17% ash.
Malawi	Nkana	14	
Mozambique	Moatize	100	
South Africa	Transvaal	proved 34,000	Part coking.
	Natal	1,000	Part coking.
	Orange Free State	2,200	Part coking.
	Cape	2,000 (approx.)	Part coking.
Swaziland	Mpaka	important	Part coking.
Tanzania	Rahaha	280	High ash.
Zambia	Kandabwe	50	High ash.
West and Central Africa:			
Congo (D.R.)	Luena	5	30% volatile 15-50% ash.
	Lukuga	over 50	30% volatile 15-50% ash.
Nigeria	Enugu	54	Non-coking, high sulphur.
	Ezimo	46	Non-coking, high sulphur.
	Orukpa	37	Non-coking, high sulphur
	Okaba	73	" " "
	Ogboyoga	107	" " "

ANNEX V

Exports of steel to African countries, 1965

	Belgium	France	Germany	Italy	Netherlands	U.K.	USA	USSR	Japan	S.Africa	Others
Algeria	3	102	10	16	-	26	-	14	-	-	3
Angola	17	13	4	-	-	5	1	-	1	-	5
Central African Customs Union	2	29	1	1	-	1	-	-	-	-	-
Congo (D.R.)	26	2	6	1	-	-	3	-	-	-	-
East Africa	23	11	9	3	2	38	-	3	40	-	1
Ethiopia	3	1	1	(6)	-	1	1	2	14	-	1
Ghana	17	2	19	(2)	-	11	1	2	5	-	15
Guinea	-	4	-	-	-	-	-	12	-	-	-
Liberia	3	1	3	-	2	-	6	-	3	-	2
Libya	14	21	30	(83)	-	53	7	2	16	-	3
Morocco	4	100	10	(2)	-	-	-	-	-	-	9
Mozambique	10	3	12	-	-	3	1	6	15	-	27
Nigeria	34	32	40	(13)	8	50	32	5	35	-	8
Rhodesia	2	1	1	1	-	17	-	-	8)		-
Zambia	1	-	2	-	-	5	-	-	-)	96	-
Sudan	12	3	4	1	1	13	5	2	6	-	6
Tunisia	22	28	9	23	-	-	11	10	-	-	15
Other a/	45	169	22	(5)	2	8	6	2	15	-	4
U.A.R.	4	34	21	9	-	23	13	32	32	-	91
S. Africa	60	62	74	155	34	210	-	-	243	-	6
Total	302	618	278	462 (174)	51	466	87	89	437	96	196

a/ Mainly former French West Africa

( )=1964

Source: Statistics of World Trade in Steel. E.C.E.

Exports of steel to African countries, 1960

	Belgium	France	Germany	Italy	Netherlands	U.K.	USA	USSR	Japan	S.Africa	Oth
Algeria	-	531	4	8	-	-	-	-	-	-	..
Angola	13	10	5	-	1	6	1	-	-	-	..
Central African Customs Union	-	..	1	-	-	-	1	-	-	-	-
Congo (D.R.)	41	..	2	-	-	-	2	-	-	-	1
East Africa	4	12	10	-	2	44	1	-	21	3	6
Ethiopia	6	..	1	4	-	-	-	1	3	-	..
Ghana	12	7	4	-	-	18	1	1	4	-	2
Guinea	1	..	1	-	-	-	-	4	-	-	..
Liberia	4	..	6	9	1	6	4	-	1	-	..
Libya	4	..	7	7	1	35	3	-	-	-	..
Morocco		..	10	2	-	-	-	6	-	-	..
Mozambique	11	..	7	-	2	-	1	-	-	19	1
Nigeria	28	..	9	-	3	58	-	-	28	-	1
Rhodesia } Zambia	5	3	3	-	1	28	3	-	-	-	..
Sudan	9	2	4	2	-	-	-	-	-	85	2
Tunisia	1	..	2	2	-	10	1	6	1	-	..
Other	56	334	3	2	-	-	-	3	-	-	3
U.A.R.	6	19	34	19	1	25	1	-	5	-	3
W. Africa	30	9	5	-	1	13	7	25	13	4	43
Total	231	928	119	55	10	81	38	-	-	-	8
					22	325	64	45	77	112	70


74.10.17