

THE ECONOMICS OF THE IRON AND STEEL INDUSTRY IN EGYPT*

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I - The Importance of the Industry

The iron and steel industry in Egypt is a relatively new arrival on the industrial scene. But it has been growing rapidly. It is essentially composed of six fairly big firms owned by the State. The position of these firms was as follows in 1969-70 :

Name	Value of Fixed assets (Million pounds)	Value of production (m.Pounds)	Number of workers	First Year of Operation
The Egyptian Iron and Steel Co.	92	24	10,052	1958
The Egyptian Copper Work	8.6	11.4	4,343	1935(Steel production in 1952)
The Delta Steel Mills	3.4	5.5	2,066	1947
The National Metal Indu- stries Company	1.9	4.8	1,954	1949
El Nasr Steel Pipes and fitting	6	3.7	1,472	1962
El Nasr Foreigns Co.	8.8	2.7	1,619	1964
El Nasr Castings Co.	0.9	1.5	1,378	1955
Total	121.6	53.6	22,884	

Source : Ministry of Industry, The Egyptian General Organisation for Metallurgical Industries. Yearbook 1969-70, Cairo, (In Arabic).

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Yet, the importance of the iron and steel industry cannot be measured only by its direct employment, wages and value of output. This is due to the fact that this industry is a key industry, and the creation of it is bound to induce the creation of a large number of satellite industries.

This industry has very high linkage effects. The linkage effects demonstrate the degree of interdependence of the iron and steel industry with other industries. They include both forward and backward linkage effects. The forward linkage effects show the proportion of the industry's total output that goes to other industries, and not to final demand. The backward linkage effects show the proportion of the industry's output which is purchased from other industries.⁽¹⁾

Chenery and Watanabe⁽²⁾ show, in their study of the degree of interdependence of various industries, that the iron and steel industry has the highest combined backward and forward linkage effects. The purchases from other industries, or the backward linkage effects, form 66% of the value of total production of the industry. While the sales to other industries, or the forward linkage effects, represent 78% of the total demand for the industry's output.

These figures, though related to industrialized countries, may be used as an approximate measure of the role of the iron and steel industry during the industrialization process.

However, we can show roughly the linkage effects of the iron and steel industry in Egypt by listing industries or sectors which supply the steel industry with its inputs, and those which purchase their materials from the iron and steel industry.

In Egypt, the iron and steel industry draws its iron ore, limestone and dolomite from local mines. These mines are run by the iron and steel industry itself. It gets its coke from the coking industry which depends on imported coal. The number

(1) For more details, see A.O. Hirschman, *The Strategy of Economic Development*, New Haven, Yale University Press, 1966, Chapter 6.

(2) *Ibid.*, pp. 105-113.

of people engaged in the iron ore mining only amounts to 1385; wages amount to L.E. 102,000⁽¹⁾.

The users of the iron and steel products include a large number of industries and establishments. They include manufacturers of tools, machinery, motor vehicles, railway wagons, ships, household durables, buildings etc⁽²⁾. This group of industries include 296 establishments, employ 74 thousand persons, pay wages of L.E. 5 million. The value of their production amounts to L.E. 42 million⁽³⁾. The above figures serve to show roughly the forward and backward linkage effects of the iron and steel industry in Egypt.

Moreover, the main requirements of the industry exist in the country and in reasonable amounts. There are large reserves of iron ore in Aswan and the Western desert (Baharya Oasis). It is only coal which is imported. As more hydro-electricity is being generated from the Aswan High Dam, and after the discovery of large deposits of natural gas, the industry is going to depend more on these cheap sources of power. These sources will partly replace coal imports in the future.

The size of market for several steel products is fairly adequate. It will grow at a faster rate when the rate of industrialization and development is resumed again to its pre 1967 level.

2 — Consumption of Steel

Consumption of steel is composed of a large number of steel products. These products are not for final consumption but go into the manufacture of a large number of goods, which are in the main, capital goods. The main consumers of steel are the following : transport, building and construction, engineering, mining, gas, electricity and water, household durables, food-canning.

(1) Central Agency for Mobilization and Statistics, Census of Industrial production (quarterly), 1970 - 71, Cairo, 1972.

(2) These industries depend partly on imports for some of their iron materials and components. Yet, the reliance upon local sources of supply has been increasing.

(3) Ibid.

Therefore, the demand for steel is diversified, and almost every industry uses iron and steel whether directly or indirectly. They use it directly as a raw material, or indirectly in the form of machinery and tools. However, industries differ widely in the amounts which they consume; similarly large differences in consumption for any industry depend on whether it is in a developed or a developing country.

For example, in the latter countries, the building industry tends to be the dominant consumer of steel. The building industry in Egypt consumed 45% of the total in 1969-70.⁽¹⁾ The proportion is only 18% in the industrialized countries. It is also noticed that when a developing country is a big producer of oil or gas, an important proportion of steel goes to pipelines (table 1).

The volume of consumption of steel in a country is related to the rate of growth of the economy, and especially, to the rate of growth of the main consuming industries.⁽²⁾ So the periods of rapid economic growth are characterized by a fast rate of steel consumption. This trend is obvious in developing countries embarking on ambitious industrialization programmes.

In Egypt, the consumption of steel has been increasing very fast (table 2). In 1950-52, the average annual consumption was 260 thousand tons; it amounted to 326 thousand tons in 1960, or it increased by 36%. In 1965, consumption reached almost 800 thousand tons; it increased by 145% over 1960 level. The period 1960-65 covered the first five year industrialization programme in Egypt. Consumption of steel reached a record in 1966, but it fell in 1967 and 1968 due to the 1967-war. Yet, consumption of steel began to rise again in 1969 and 1970 when it reached a new record of 0.9 million tons in the latter year.⁽³⁾

(1) Ministry of Industry, The General Organization of Metallurgical Industries, Yearbook 1969/70, p. 37 (in Arabic).

(2) O.E.C.D., The Iron and Steel Industry (in 1970 and trends in 1971), Paris, 1971, pp. 12-15.

(3) The consumption figures include all steel consumed whether in its crude, processed or highly sophisticated forms such as machinery and transport equipment of all sorts.

Furthermore, over 50% of the iron and steel consumed in Egypt, nowadays, is covered by local production. The degree of self-sufficiency has been increasing all the time. The proportion of consumption covered by local production increased from 4% in 1950, to 37% in 1957, to 46% in 1960, to 54% in 1964, and to 60% in 1968/69.⁽¹⁾ It is expected that by 1975/76 (when the new iron and steel complex is completed) total production is going to exceed total consumption, leaving a part to be exported.

However, when we say that total production equates or exceeds total consumption, this, of course, does not mean that the country stops importing steel products entirely. In the case of the steel industry, it is not only difficult to produce all steel products locally, but it is also uneconomic to do so. Even the industrial countries, still rely on imports for certain steel products, though they are net exporters of steel. This is because steel products are so diverse; for some of these products the local demand is so small that it does not justify local production.

So it is reasonable to say that while the steel production is increasing rapidly in developing countries, these countries must concentrate more on the production of steel products which enjoy a fairly large market. They ought to continue to rely on imports for the many other steel products which are consumed in small amounts. This method will not only avoid production at high cost, but it will also avoid establishing a large number of costly rolling mills in developing countries.

3 — PRODUCTION

Steel products are numerous and any one developing country should not produce all or most of them at once. The burden of capital requirements is great, and the market for many of these products is limited. Needless to say, experience and skills are limited. So it is advisable for any country to concentrate on

(1) Economic Commission for Europe, "Iron and Steel Industry", Industrialization and Productivity. Bulletin No. 13, 1969, table 14, p. 82; The General Organization for Metal Industries, Yearbook, p. 19.

production of a few steel products, and to add more of them as the market expands later on.

Moreover, the steel industry should be established by stages. The first stage involves the creation of a non-integrated plant. It includes a small rolling mill to process certain products such as concrete bars, tubes, heavy and light sections. The mill depends on imported crude steel such as blooms, billets and slabs.

The second stage includes the establishment of a small electric furnace to smelt local and imported scrap and to supply the rolling mill with its requirements of steel. In this case, we have a semi-integrated plant which comprises an electric furnace and a rolling mill. In the third stage, we have a fully integrated plant. It includes rolling mills, steel converters, and also blast furnaces which smelt iron ore.

Thus the development of the steel industry is carried out through backward integration. As the industry starts by producing final steel products (concrete bars, tubes, etc.) from imported steel. Later on a small electric furnace is created alongside the rolling mill. Finally, a blast furnace is added to smelt local or imported iron ore.⁽¹⁾

In Egypt, the creation of the steel industry started in 1947 when the Delta Steel Mills built a small plant to produce concrete bars for the building industry. The plant included a 3 ton electric furnace and a rolling mill to process the steel billets. The factory has been depending on local and imported scrap. So the steel industry started by the two stages together. But only one kind of finished steel was made. More electric furnaces were added later on. The Delta Steel Mills now has 6 electric furnaces of capacities ranging between 3 tons and 25 tons (table 3).

(1) Developing countries should not start the iron and steel industry by establishing blast furnaces to process local ores and to export pig iron or crude steel. This is because it is easier to export iron ore than pig iron or crude steel. The export of these products is likely to encounter severe competition from the products of the industrialized countries.

The second steel plant was created in 1949 by the National Metal Industries Co. to produce concrete bars for the building industry. The plant included one rolling mill and one Siemens-Martin steel converter of the capacity of 25 tons (table 3). A second rolling mill for light sections was added in 1960, and a second steel converter of 35 tons was added in 1965. This company concentrates on the production of concrete bars.

The third plant belongs to the Egyptians Copper Works of Alexandria. This Company added a small steel plant in 1953 to produce concrete bars. The company now has 3 Siemens-Martin steel furnaces, two electric furnaces, and a number of rolling mills (table 3). It depends on imported scrap and pig iron from local and foreign sources.

In 1958, the first fully integrated iron and steel plant began production. This plant belongs to the Egyptian Iron and Steel Company. It smelts iron ore drawn from the Aswan mine. From the autumn of 1973, the plant drawn its ore supplies from the Baharya Oasis mine in the Western Desert, 300 Km. South West of Cairo. The steel plant includes 2 blast furnaces (400 tons/day each), 4 Thomas steel converters (17 tons each) and 2 electric furnaces (12 tons each). The last two furnaces process scrap collected from the rolling mills.

The plant has also a number of different rolling mills which produce various kinds of steel products such as heavy and light sections, reinforced concrete bars, angles, plates, sheets and galvanized sheets. The company produces almost all kinds of semi-finished and finished steel products.

El-Nasr Steel Pipes & Fittings was created in 1961 to manufacture tubes of different kinds. It draws its raw materials from the Egyptian Iron and Steel Co. El-Nasr Forgings Co. was created in 1964. It produces a variety of forged products, such as parts of the body of motor vehicles, railway wagons, tools and hard ware. chains and stampings. It gets its steel from the Egyptian Iron and Steel Company. El-Nasr. Castings Co. is specialized in the production of iron castings such as pipes for water and other purposes.

The Egyptian Iron and Steel Co. is the biggest among the iron and steel companies working in Egypt. In 1969/70, the value of its production was L.E. 24 million, which was almost equal to the value of the combined output of the other 6 companies. The number of workers amounted to 10 thousand, which was also equal to the combined number of workers of the other six companies.

Moreover, when the iron and steel complex is completed in 1975, the plants of the Egyptian Iron and Steel Co. will be integrated in the complex. The productive capacity of the iron and steel industry will be largely increased. The production of pig iron will increase from about 300 thousand tons to 1,750 thousand tons. Moreover, the production of crude steel will increase from 200 thousand tons (table 4) to 1.5 million tons. Also, the productive capacity of the finished steel products will be greatly increased. More details about this project will be given throughout this paper.

PRODUCTION PROCESS :

1 — The manufacture of pig iron (blast furnaces) :

Pig iron is produced by charging the blast furnaces with iron ore pellets, coke and some other materials. Several developments have been introduced into this process in order to reduce the cost of production of pig iron by reducing the cost of fuel.⁽¹⁾

2 — The manufacture of steel ingots (steel converters) :

There are several processes for the production of steel ingots. The choice of the process is determined by :

- a) the type of raw material used, i.e., the chemical composition of iron ore, the abundance or scarcity of scrap etc.;
- b) the type of steel required, i.e., ordinary (or general purpose steel) or steel for special uses such as stainless steel, steel for the manufacture of hard-ware, or high-speed tools.

(1) For more details of these developments, see (UNIDO, Iron and Steel Industry, Bulletin No. 5, New York, 1969, pp. 11-12.

We shall give a brief description of the steel making processes with special emphasis on the oxygen (or L.D.) process.

a) The Bessemer process :

This process was invented by Sir Henry Bessemer in 1856. A blast of air⁽¹⁾ was blown through the molten pig iron. Carbon and silicon were burned out by the air, but were restored again by the addition of ferro-manganese or spiegeleisen. This process uses little scrap. It also takes shorter time, which reduces its consumption of fuel when compared with the open-hearth process.⁽²⁾

b) The open-hearth process (Simens-Martin) :

This process was invented in 1869. It has the following advantages :⁽³⁾

- 1— Steel produced is of a more reliable type, as metal can be tested during conversion.
- 2— This process uses a lot of scrap, so it is suitable for industrial countries which are rich in it.

c) The Gilchrist and Thomas process :

The two earlier processes could not originally process iron ore which contained a high proportion of phosphorous. As most of the iron ore in the world was phosphoric, so the use of the Bessemer and open-hearth processes was limited.

In 1879, Gilchrist and Thomas discovered that the phosphorous in the iron ore could be absorbed during conversion by the addition of cheap basic material such as limestone. Therefore, both former processes began to use phosphoric iron ore on a large scale. The steel produced is known as basic steel. The basic slag produced is used in agriculture as a cheap phosphoric fertilizer.

(1) Now it is replaced or supplemented by oxygen.

(2) G.C. Allen, *British Industries and Their Organization*, London, Longmans, 1959, p. 99.

(3) *Ibid*, p. 102.

d) The electric-arc process :

The use of electric furnaces has become widespread. This type of furnaces smelts scrap only. This process is economic on a small scale, especially when cheap electric power is available.

e) The Oxygen (or L.D.) process :

The discovery of the oxygen process was one of the most important discoveries in steelmaking in the post-war years. In this process, pure oxygen blast is passed through the molten pig iron to oxidize the existing impurities.

This process has the following merits over the existing open-hearth process :

- 1—It converts pig iron into steel in a shorter time with the resultant saving in fuel costs.
- 2—Its investment and operating costs are lower⁽¹⁾. For example, in a steel plant of a capacity of 500 thousand tons a year, the investment cost per annual ton is estimated at \$ 35.70 compared with \$ 53.30 for the open-hearth furnace. Production costs are \$ 12.80 and \$ 21.62 per ton for the two processes respectively.⁽²⁾
- 3—It uses little scrap, so it is well suited for countries which are poor in scrap such as Egypt.

This process has rapidly replaced the open-hearth process. In the next few years, the oxygen and electric will be processes very likely to be the dominant steel processes in both developed and developing countries. The first process deals with the conversion of pig iron, and the latter with the bulk of scrap.

The developing countries, which are now building steel plants, are in a position to adopt these economic processes. In the meantime, the industrial countries find it difficult and costly to scrap their existing open-hearth furnaces.⁽³⁾

(1) UNIDO, Report of the Second Interregional Iron and Steel Symposium, New York, U.N., 1969, p. 93.

(2) UNIDO, Iron and Steel Industry, Bulletin No. 5, New York, U. N., 1969, p. 13.

(3) UNIDO, Report of the Second Interregional Iron and Steel..., p. 41.

In Egypt, the oxygen converters will be used by the large iron and steel complex which will start production late in 1973. It is planned to work at full capacity in 1975. It will include 3 oxygen converters (80 tons each). Thus in the next few years, most of the steel produced in the country will become oxygen steel.

However, the existing steel plants in Egypt include three types of steel converters, namely, Thomas, open-hearth, and electric furnaces (table 3). The Egyptian Iron and Steel Co. has 4 Thomas converters (17 tons each), which process pig iron coming from the blast furnaces. It has also 2 electric furnaces (12 tons each), to process scrap collected from the rolling mills. The remaining steel firms have electric and open-hearth furnaces which depend solely or mainly on scrap for their steel.

3—The blooming and rolling process (the continuous casting process) :

The continuous casting process is another important development in the technology of blooming and rolling of steel. In this process a continuous stream of liquid steel is poured into a copper mould and cooled by water. When it solidifies it is cut to the required sizes for use in a finishing mill.

This process is superior and more economic when compared with the traditional method of casting ingots. It eliminates the ingot phase and its requirements. Thus it saves the capital cost of making ingots and cogging and rolling them into billets.⁽¹⁾ For example, in a plant of a capacity of 326 thousand tons of billets per annum, the investment cost per annual ton is \$ 51.70 by the use of a blooming mill. It is only \$ 11.40 by the use of the continuous casting process. Moreover, the production cost of converting a ton of liquid steel into billets, for the same size of plant, is \$ 10.87 by the use of a blooming mill and only \$ 3.77 by the use of the continuous casting process.⁽²⁾

(1) UNIDO, Report of the Second Interregional Iron and Steel..., p. 13 and p. 136; D. Burn, "Steel" in D. Burn, (edit.), *Structure of British Industry* (Vol. 1), London, Cambridge University Press, 1958, p. 266.

(2) UNIDO, *Iron and Steel Industry*, p. 14.

This process can be used in place of the existing blooming mill. It can also be used alongside with it, especially when the capacity of the steel converters exceeds the capacity of the existing blooming or slabbing facilities.

However, the continuous casting process is economic on a small scale, and so it suits the small and medium size steel plants. The developing countries establishing steel plants are advised to use continuous casting process alongside oxygen converters.

The continuous casting process will be used in the new iron and steel complex. Six units will be built alongside the existing blooming mills in the old steel factory which belongs to the Egyptian Iron and Steel Co.

4. RAW MATERIALS AND FUEL

The main raw materials used in the manufacture of iron and steel are : iron ore, coke, limestone, dolomite, scrap and steel alloys. However, the first two are the most important from the point of view of quantity and value of the amounts used.

Iron ore :

Iron ore is not charged directly into the blast furnace. The metal content in the ore may be low. It quite often contains some undesirable impurities. It is, however, more economic to prepare the ore before it is sued. So the ore is subjected to certain processes before it goes to the blast furnace. These processes-which were developed in the post-war years — include sintering and pelletization.⁽¹⁾

These processes aim at increasing the iron (or Fe) content in the ore. It should not be less than 60 or 65 per cent. Also, certain of the impurities should be eliminated. Moreover, iron ore fines cannot be charged into the furnace. So iron ore must be prepared in the form of small balls (called pellets) of equal shape and dimensions. These preparatory processes have managed to reduce the cost of production of pig iron. This is done by increasing the yield of the blast furnace, and by reducing the amount of fuel consumed.⁽²⁾

(1) They are also known by beneficiation of iron ore.

(2) For more details of these processes, see U.N., The World Market for Iron Ore, New York, 1968, pp. 6-12.

In Egypt, iron ore is so far used by the Egyptian Iron and Steel Co., it will also be used by the complex. The company has been depending on the Aswan mine since it began production in 1958. This mine is 800 Km. south of Cairo. It has a reserve of 25 million tons of iron ore. This ore has the following elements :⁽¹⁾

46% Fe (or iron) content

18% Silicon

2% Phosphorous⁽²⁾

This type of ore is relatively poor in its iron content,⁽³⁾ and has a high proportion of harmful impurities such as silicon and phosphorous. The annual production is 500 thousand tons. The mine is owned and run by the Egyptian Iron and Steel Co. itself.

Iron ore production from this mine was going to stop completely by the end of 1973. The old steel factory and the new complex will depend on the Baharya Oasis mine. It is situated in the Western Desert, 300 Km. south-west of Cairo. This mine has the following advantages over the Aswan mine.

- a) The ore has better qualities; it contains 53% Fe content, 7% silicon and 0.5% phosphorous.⁽⁴⁾ So it is richer in iron content and has lower proportions of harmful impurities.
- b) The new mine has an assured reserve of 120 million tons.

(1) The Industrial Development Centre for Arab States (IDCAS), A survey of the Iron and Steel Industry in the Arab States, Cairo, 1970, chapter 3, p. 24 (In Arabic).

(2) Phosphorous content should not exceed 0.2%.

(3) The iron content is as follows in the ores of the following group of countries :

Algeria (52-56), Angola (64-65), Venezuela (63-68), India (55-69), Australia (60-67), France (30-32), W. Germany (27), Spain (48-53), Sweden (52-61), and U.K. (20-34). See U.N., The World Market for Iron Ore, 1968, Table 18, pp. 28-30.

(4) IDCAS, *ibid.* chapter 3, p. 24.

- c) It is much nearer to the steel factories. This will reduce the cost of transport.

All these advantages will certainly help in reducing the cost of pig iron production.

Annual production of iron ore is expected to rise to 3.5 million tons; part of it will be exported. The ore will be carried to the factories by railways, which have been built between the new mine and the factories.

Coke :

All types of fuel are now being used by the iron and steel industry. Coke is being used in the blast furnaces for the reduction of iron ore. The amount used per ton of pig iron has been falling all the time, due to innovations in the iron and steel industry. Moreover, coke has been supplemented by gas and liquid fuel which are relatively cheaper.

The use of electric power has been increasing especially in electric furnaces and rolling mills. This source of power is important in countries which are poor in coal and oil but rich in cheap hydro-electric power, such as Egypt.

In Egypt, there is local coal. The iron and steel industry depends on imports for its coal. Originally, the steel industry had to import coke up to 1963, when the coke industry began production. The coke plant gets its coal from abroad. It produces about 330 thousand tons,⁽¹⁾ mostly (300 thousand tons) taken by the Egyptian Iron and Steel Co.

A ton of coke is sold to the steel company at L.E. 16. This price is considered high by the user company. The price of imported coke is about L.E. 13 per ton C.I.F. Alexandria. So the price of home-produced coke is about 20% higher than the price of imported coke. Moreover, the coke company is pressing hard to raise its selling price to L.E. 25 per ton, or by about 56%. The new price, if it is achieved, will be 90% above the world price.

(1) Capacity of the coke plant will be enlarged to meet the expected big demand from the iron and steel complex.

The coke company is complaining that it is unable to cover its costs. The reason is that the coke company is unable to make full use of its coke-oven gas. Only a small part of this gas is sold to the Egyptian Iron and Steel Company, which uses it in its blast furnaces. Another small part is used by a small ammonia plant producing fertilizers. But the bulk of the coke-oven gas is wasted.⁽¹⁾

Unless this gas is fully used, for example, in the manufacture of nitrogenous fertilizers and as a fuel in other industries, the cost of coke will remain high. In this case, there is a possibility of raising the selling price of coke which will appreciably raise the cost of pig iron.⁽²⁾

5. COSTS OF PRODUCTION

Broadly speaking, costs of production are classified into the following groups :

- 1—Raw materials and supplies; it may include the cost of power and fuel.
- 2—Labour; it includes all wages and related payments, but it does not include the wages of the maintenance staff.
- 3—Capital charges; it includes depreciation, labour and materials for maintenance, the normal remuneration of capital and miscellaneous charges, such as short-term interest and insurance charges.

As the iron and steel industry is a heavy industry, so the weight of the capital charges is large. Table 5, shows that

(1) In Europe, coke-oven gas is facing a severe competition from the cheap natural gas. So the coking industry, is facing the problem of selling its gas at suitable prices. Moreover, its loss of revenue is so great that it could not offset it by raising the price of coke. (OECD, Problems and Prospects in Coking Industry, Paris, 1972, pp. 11-12.

(2) The cost of coke constitutes 25% of the total cost of production of pig iron. Every ton of pig iron requires a ton of coke. However, coke consumption is expected to fall to 600 Kg. when the iron ore from the Baharya mine is used.

its share amounts to about 60% of total production costs for a steel plant of the size of 50 thousand tons per annum. It rises to about 66% for the larger sizes. If maintenance charges are added to capital charges the latter's share will rise to about 70% of the total cost of production. The share of raw materials (including fuel) and labour is only 30%.

It should be pointed out, however, that the example of the cost structure given by table 5 above is related to the cost of finished steel products. In this case, the size of capital charges is relatively great compared with the lower stages of production such as crude steel or pig iron. The cost structure of pig iron manufacture of the Egyptian Iron and Steel Company is approximately as follows :⁽¹⁾

Cost Item	%	Cost item	%
Iron ore and other materials	20	Wages	19
Coke	25	Capital charges	24
Fuel	8	Miscellaneous	5
		Total	100

These figures show the big share (53%) of the raw material (including coke) and fuel in the stage of pig iron manufacture.

Level of production costs :

The level of production costs of the Egyptian iron and steel industry is relatively high for the following reasons :

- 1 — Higher Costs of investment. It is estimated to be 25%, at least, above the European level.⁽²⁾
- 2 — Higher costs of infrastructure which are carried out by the steel factories. The Egyptian Iron and Steel Co., for example, had to build roads, houses, power stations, railway tracks, and the like. The New Iron and Steel Complex will also be burdened by a big share of similar infrastructure projects. For example, the

(1) Figures supplied by the company.

(2) This is mostly due to : 1) transport costs of machinery and
2) high interest rates on loans.

total cost of the project is estimated at L.E. 310 million; of which L.E. 208 million will be allocated to the expansion of the iron and steel capacity. The remaining L.E. 102 million, or about one-third of the total cost of the complex, will be spent mostly on related infrastructure projects.

- 3 — The use of lower quality iron ore (44% Fe content)⁽¹⁾ with a high phosphorous content (2%).
- 4 — The high cost of coke. The selling price of local produced coke of L.E. 16 per ton is about 20% higher than the price of imported coke.
- 5 — The use of small scale plants. This applies to all the existing iron and steel plants, and to all stages of production, namely, pig iron, crude steel and finished steel. We shall deal with this problem in detail later on.
- 6 — The existence of high rate of unused capacity in the rolling mills. In the existing steel plants, all blast furnaces and steel converters are working at full capacity. The finishing stages of steel making with a high degree of unused capacity, as we shall see later. This is due mostly to the shortage of crude steel because of inadequate productive capacity of it. However, all factories are now extending their steel capacity. Besides, the creation of the large iron and steel complex.

Factors leading to lower costs in future :

On the other hand, there are positive factors which are going to work for lower costs of production of iron and steel in the near future. These factors include :

- (1) This proportion of iron content in the Egyptian ore is lower than the iron content in the ores of many countries (see footnote p. 17). But it is higher than in some industrial countries such as Britain, W. Germany and France. But these countries depend mostly on imports of rich ores. Moreover, if these countries use poor ores, the expected rise in the cost of ore, will be compensated by: 1) higher productivity of labour, and 2) greater economies of large production.

- 1—The use of relatively better iron ore from Baharya oasis, which is richer in Fe content (53%) and has little phosphorous (0.5%) in it. This will help in reducing the cost of transport, the cost of beneficiation of iron ore, and the cost of coke and fuel. The consumption of coke per ton is expected to fall from 1000 Kg. to 600 Kg or by 40%⁽¹⁾.
- 2—The use of larger production units by the complex. This includes all production stages, namely, pig iron, crude steel and finished steel.
- 3—The use of up-to-date technology which includes the introduction of oxygen converters and continuous casting process. This will reduce both the capital and operating costs.

A part of this expected fall in the cost of production will not be achieved if the new complex works with a large degree of unused capacity. The higher the degree of utilization of production units of the complex, the lower will be the cost of production. The problem of unused capacity will be dealt with later on.

6. SIZE OF PLANT AND ECONOMIES OF SCALE :

We mentioned above that the level of the cost of production is partly affected by the size of plant. Generally speaking, as the size of plant increases the unit cost of production tends to fall as shown by table 5. This table illustrates the components of the cost of production, and the variations in each component at different scales of production.

It shows that the cost of production of a ton of finished steel falls from \$ 209 at a capacity of 50 thousand tons, to \$

(1) In the main O.E.C.D. countries, a ton of pig iron requires 500 to 550 Kg, except in Japan where it requires 430 Kg. only. However, the rate of coke consumption depends on : 1) modernization of iron making factories, 2) nature of iron ore, and 3) the quality of coke available. (O.E.C.D. Problems and Prospects in the Coking Industry in the O.E.C.D. Countries, Paris, 1972, p. 21).

159 at a capacity of 250 thousand tons, or by 25%. As capacity rises to 500 thousand tons, unit cost falls by 35% over the original small scale of production. When capacity reaches a million tons the fall in cost is 39%. It is obvious that while a bigger size of production permits a fall in cost, most of this fall is achieved at the size of half a million ton.

Moreover, most of the fall in unit cost of production, in the scale of 500 thousand tons, is due to the fall in investment and labour costs. The decline in capital costs is 29% (and 32% for capital and maintenance charges), while the fall in labour cost is 75%. The drop in the cost of raw materials and fuel is very little. It is only 10% for the respected sizes.

In general, the amount of raw materials and fuel increases almost in the same proportion as the increase in production.⁽¹⁾ If there is a minor fall in the cost of raw materials, it is mostly due to bulk buying and shipping, and to reduced waste in handling.⁽²⁾ There is also a possible saving in fuel. As the capacity of the blast furnace is increased its volume increases faster than its wall area; so there is little loss in radiation.⁽³⁾ So the saving in the cost of fuel is more obvious in the case of large blast furnaces.

The big saving in labour costs, mentioned above, is due to the fact that the modern steel plants use continuous processes, automated machines, and lately the computer. Therefore, most of the labour engaged is of a supervisory nature. Their number becomes independent of the size of operations, and remains unchanged or changes a little as the scale of production increases⁽⁴⁾. So when the scale of operations is enlarged the labour cost per unit of output declines substantially.

(1) U.N., "Problems of Size of Plant in Industry in Under-Developed Countries," *Industrialization and Productivity*, Bulletin No. 2, 1959, p. 9.

(2) U.N., "Plant Size and Economies of Scale," *Industrialization and Productivity*, Bulletin No. 8, 1964, p. 56.

(3) D. Burn, "Steel" in D. Burn (edit.), *Structure of British Industry* (Vol. 1), p. 264.

(4) U.N., "Plant Size and Economies of Scale", *Industrialization and Productivity*, Bulletin No. 8, p. 57.

As the iron and steel industry is composed of several production stages or processes, so it is interesting to examine the minimum economic size of each stage, and so the magnitude of the economies of scale and the scale of production which gives most of these economies.

- 1—The stage of pig iron making (blast furnace) : The production of pig iron is only economic when it is done on large scale. In the present state of technology, a blast furnace producing less than 800 tons a day (or 240 thousand tons a year)⁽¹⁾ is considered a small furnace, from 800 to 1,500 tons a day a large furnace.⁽²⁾

Furthermore, economies of scale are to be obtained with every increase in the size of the furnace until it reaches 1.3 million tons a year⁽³⁾. But even if the size of the market is large enough to match this big furnace. It is considered risky and hazardous for an integrated plant to depend for its pig iron on one blast furnace only. As the blast furnace gets out of commission periodically for month or so to be re-lined, and frequently during the day to supply batches of the metal.⁽⁴⁾ So there must be more than one furnace, two for instance, each of a capacity of 65 thousand tons a year.

The capacity of the blast furnaces in the Egyptian Iron and Steel Co., is 400 tons a day (or 120 thousand tons a year) for each. So both of them are considered very small, and so the economies of large scale

(1) The industrial year is only 300 days; the rest is lost in stoppage for maintenance and repair. Yet the industrial year can be extended by squeezing the days of repair. But this is not good in the long run, as it cuts short the life of machines.

(2) UNIDO, Report of the Second Interregional Iron and Steel Symposium, p. 124.

(3) UNIDO. Iron and Steel Industry, Bulletin No. 5 New York, 1962, p. 20.

(4) D. Burn, *op. cit.*, p. 264.

production are not achieved.⁽¹⁾ The new blast furnaces are larger, each of a capacity of 1000 tons a day (or 300 thousand tons a year). So they are considered medium size furnaces. Therefore, a part of the economies of large scale production is achieved.

- 2—The stage of steel making (steel converters) : The predominant process for the manufacture of steel nowadays, is the oxygen process. This process is only economic if it is performed on large scale; of at least 700 thousand tons year. Moreover, it is very uneconomic if the scale of production is below 350 thousand tons a year⁽²⁾. On the other hand, the electric arc furnaces are economic on a small scale provided that there is cheap electric power.

In Egypt, the existing Thomas converters in the Iron and Steel Co., are of a capacity of 50 thousand tons a year for each.⁽³⁾ So they are very small. But the new oxygen converters, which are now under construction, are of a capacity of about 350-400 thousand tons a year for each converter. So the new converters can be considered relatively more economic.

- 3—The stage of semi-finished and finished steel (the rolling mills) :

Generally speaking, the rolling process includes the production of flat and non-flat products. The non-flat products can be produced economically on a relatively smaller scale. Machinery used is flexible and can be adapted to produce different products. A rolling mill producing shapes usually has a high degree of flexibility. Also, a rolling mill producing concrete bars of an annual capacity of 30 thousand tons can be as economic as a rolling mill 10 times larger⁽⁴⁾. The

(1) However, small blast furnaces are economic provided that there are two conditions : a) rich iron ore and b) cheap coke. Both these conditions do not exist in Egypt.

(2) UNIDO, Report of the Second Symposium..., p. 124.

(3) For more details of capacities of the existing steel converters of all companies, see table 3.

(4) UNIDO, Report of the Second Interregional Iron and Steel Symposium, p. 124.

production of tubes is also economic on a small scale and does not present any problems in this regard.

So one may say that the rolling mills producing non-flat products are mostly economic. For example, the scale of production of concrete bars in all steel companies is economic. It ranges between 30 thousand to 70 thousand tons a year in the producing companies⁽¹⁾.

For flat products, the problem of economies of scale is complicated. This is mainly because the type of machinery used by the rolling mills is inflexible. So a rolling mill producing flat products, i.e., sheets, plates, tin-plate, etc. is only economic on large scale⁽²⁾.

In Egypt, the rolling mill producing plates in the Iron and Steel Co., of annual capacity of 75 thousand tons, is therefore operating at an un-economic scale. But the strip mill which has a capacity of 300 thousand tons (to be extended to 500 thousand tons in 1975) is certainly operating at an economic scale. Moreover, the expansion in the capacity of all rolling mills producing flat and non-flat products will, undoubtedly, make possible a fuller achievement of economies of scale.

7 — CAPACITY UTILIZATION

In developing countries, the creation of capital intensive industries such as iron and steel, is always accompanied by the appearance of a significant margin of excess capacity. Needless to say that the presence of unused capacity of such a degree will adversely affect costs of production, which are already high. Such a big rise in iron and steel costs will raise the cost of production of the large number of industries using iron and steel products. This will undoubtedly hinder the export potentialities of all these industries.

The presence of such excess capacity in the iron and steel industry can be traced to one or more of the following reasons:-

- 1 — The iron and steel industry is distinguished by the presence of a high degree of indivisibilities. The productive capacity

(1) IDCAS, op. cit., chapter 2, p. 124.

(2) UNIDO, Report of the Second..., p. 125.

of pig iron, crude and finished steel cannot be increased smoothly or continuously. It can only be increased by discontinuous jumps, which are sometimes substantial. This is due to the economies of a big machine, a blast furnace or a steel converter.

- 2 — The optimum size of plant has been increasing all the time. Moreover, the manufacturers of steel plants produce large units which suit the markets of the industrial countries. The developing countries have to buy these large plants. As there is no technology designed specifically to suit the small needs of the developing countries.
- 3 — As the demand for iron and steel is increasing rapidly, the capacity of the new plants should be designed with the presence of a suitable degree of excess capacity. So the size of plant selected should be large — but not too large — for the present level of demand. The magnitude of excess capacity will be diminished gradually with every growth in demand until capacity is fully utilized. Then productive capacity should be extended to meet any further growth in demand.
- 4 — The presence of unused capacity, in all or part of the industry, may be caused by the shortage of raw materials and supplies. A general shortage of raw materials can be due to one of the following factors :
 - (a) "inadequate supply of indigenous materials;
 - (b) lack of foreign exchange for importing raw materials;
 - (c) high cost of raw materials;
 - (d) uncertain deliveries of raw materials;
 - (e) prohibitively expensive or poorly organized transport of raw materials;
 - (f) inferior quality of raw materials;
 - (g) variations in the quality of raw materials and lack of standardization."⁽¹⁾

(1) UNIDO, "Industrial Excess Capacity and its Utilization for Export", Industrialization and productivity, Bulletin No. 15, 1970, p. 66.

In the case of the iron and steel industry in Egypt, there is no overall existence of excess capacity. The excess capacity is only found in some sections of the industry. The other sections of the industry work at full capacity, sometimes intensively by reducing to minimum the time allocated for maintenance and repairs.

Generally speaking, all iron and steel firms complain from the severe shortage of intermediate steel products such as blooms, slabs and billets. This is due to :

- 1 — The smaller capacity of the existing crude steel production:
- 2 — The imbalance between the successive stages of production in the industry. In other words, the presence of relatively larger rolling facilities compared with a smaller steel productives facilities.
- 3 — The shortage of foreign exchange to import the required amounts of crude steel products for the rolling mills.

Table 6 shows the magnitude of unused capacities in the blooming and rolling mills. The degree of unused capacity is 40% for blooms and 70% for slabs. This section of the industry supplies the rolling mills with the intermediate products which are to be processed into final steel products such as heavy and light sections, angles, wire rods, sheets plates, tinplate, etc.

In the rolling mill section, there is also large unused capacity; 53% for the heavy sections and 35% for the light sections. The strip mill works at one-third of its capacity and depends on slabs of steel imported from the Soviet Union.⁽¹⁾ This mill will, in the near future, get its slabs from the complex.

When the iron and steel complex starts production, it will supply the rolling mills with their requirements of steel. So from this year (1974), the degree of utilization of capacities of

(1) Half the product of this mill is exported to the Soviet Union according to an agreement with Egypt.

blooming and rolling facilities will be gradually increased until they are fully used towards the end of the seventies.

The question remains, however, as to whether there is going to be excess capacity in the industry when the complex is completed by 1975. It is estimated that by 1975 the maximum capacity of pig iron will be 1.75 million tons, and that of steel 1.5 million tons. A surplus of pig iron of 250 thousand tons will be expected to appear; it will be exported to the Soviet Union according to an agreement with it. The remaining pig iron will be used in the production of steel which is expected to be 1.5 million tons.

A part from this amount of pig iron, there is no indication of a possible existence of any significant margin of surplus capacity in the industry. This is due to the fact that consumption of steel has been increasing very fast. It increased from an annual average of 262 thousand tons during 1958-60 to 554 thousand tons a year during 1961-65, and to 774 thousand tons a year during 1966-70⁽¹⁾ (table 2).

Moreover, consumption is bound to increase even further if the development programmes are resumed again at their full scale in the near future. Furthermore, there is a suggestion that consumption of steel is going to exceed production early in 1980's. An extension of productive capacity will then be necessary.

8 — DEGREE OF VERTICAL INTEGRATION :

The iron and steel industry is characterized by the presence of a high degree of vertical integration. This means that each firm is engaged in more than one productive process. This integration may be backward towards the raw material supplies by owning and running iron ore and coal mines. It may also be forward by running plants which are engaged in the production of bridges, ships, railway wagons, locomotives, oilfield equipment, machines of different kinds, tools, etc.

(1) These figures include all steel products : crude, processed and highly sophisticated machinery and transport equipment from local and foreign sources.

In the following, we are going to show all processes of production and distribution of iron and steel. These processes are as follows :⁽¹⁾

Process	Product	Plant
1. Mining	Coal, iron ore, and limestone	Mines, quarries, steamships, docks, railroads.
2. Preparation of materials	Coke ore concentrates	Coke ovens "Beneficiation" plants.
3. Smelting	Pig iron	Blast furnaces
4. Refining	Ingot steel	Open-hearth furnaces, Bessemer converters, oxygen converters, electric furnaces.
5. Rolling	Semifinished steel (blooms, billets, bars, slabs, tube rounds, and rods)	Rolling mills
6. Finishing	Finished steel products (sheet, strip, plates, bars, rails, tin-plate, pipe, wire, structural shapes.)	Rolling mills, tin-plate, mill, pipe mills, and a great variety of other finishing mills.
7. Fabrication	Manufactured steel products (ships, woven wire fence, buildings, bridges, oil field equipment.)	Manufacturing plants and contracting offices of all sorts.
8. Distribution		Warehouses and salesmen.

Each firm may perform some of the above-mentioned processes. Yet there is a strong trend towards concentration of more processes under the control of one firm. The integration of processes has certain advantages as follows :

- "a) decreased marketing expenses;
- b) stability of operations;
- c) certainty of supplies of materials and services;
- d) better control over product distribution;
- e) tighter quality control;
- f) prompt revision of production and distribution policies;
- g) better inventory control;

(1) Quoted from L.W. Weiss, *Economics and American Industry*, New York, John Wiley, 1961, p. 271.

- h) additional profit margins or the ability to charge lower prices on final products."⁽¹⁾

Over and above these advantages of vertical integration, there are more advantages which can be obtained by the firm which combines a number of production processes in one place. First, if the firm combines together in one location blast furnaces, steel converters and rolling mills, the hot metal can pass from the blast furnace to the steel converters and from these to the rolling mills. It avoids the cost of reheating the materials.⁽²⁾

Secondly, gases and waste heat coming from coke ovens, blast furnaces and steel converters, can be used to provide heat and fuel to the rolling mills, power stations, and the like⁽³⁾.

Both these advantages of integration of processes will undoubtedly help in reducing the cost of fuel, which represents a high proportion in the total cost of production.

Thirdly, there is a large economy in the transport costs within an integrated steel plant. This is due to the fact that iron and steel products lose part of their weight during the subsequent production processes. For example, only 70 to 75% of steel ingot is made into finished product. The rest is scrap which is recorded and used again in the manufacture of steel.⁽⁴⁾

In Egypt, the iron and steel firms started production by combining two basic processes, namely the smelting of scrap in small electric furnaces and the rolling of crude steel into finished products, mainly concrete bars for building purposes. It was only in 1958, when the Egyptian Iron and Steel Co. started production, that the degree of vertical integration in the industry was increased. The vertical integration extended backwardly towards the source of raw materials (iron ore, limestone and dolomite) passing by the manufacture of pig iron.

(1) Quoted from K. J. Blois, "Vertical Quasi-Integration", journal of Industrial Economics, July 1972, pp. 253-4.

(2) Weiss, op. cit., p. 272.

(3) Allen, op. cit., p. 104.

(4) Burn, op. cit., p. 264.

This firm performs the following processes :

- 1 — mining iron ore, limestone and dolomite;
- 2 — preparation of ore ;
- 3 — smelting iron ore in the blast furnaces;
- 4 — the manufacture of steel in the steel converters;
- 5 — the rolling of steel into semi-finished products such as blooms, billets, slabs and bars;
- 6 — the manufacture of multiple of finished steel products such as heavy and light sections, angles, bars, wire, tin - plate, sheets, plates, rails, etc. The Company does not produce its coke ; it gets it (together with coke oven gas) from the near by coke company.

So we may say that the Iron and Steel Co. is fully integrated especially backwardly. Its operations stop at making a number of finished steel products which can be used directly by a large number of industries such as, building and construction; railway wagons, food canning, house-hold durables, motor cars, electricity generation, tools, etc.

Other firms are highly specialized. They concentrate on only one production stage. For example, the Nasr Co. for Tubes is specialized in the manufacture of different kinds of tubes. It gets its raw materials from the Iron and Steel Co. The Nasr Co. for Forgings gets its raw materials from the Iron and Steel Co., and processes them into parts of car bodies, railway wagons, tools, etc.

So we may classify the iron and steel firms working in Egypt into three groups as far as vertical integration is concerned. The first group is specialized mainly in one production process, namely, the manufacture of tubes, forges, or iron castings. The second group⁽¹⁾ combines plants which are mainly engaged in two successive processes, namely, the manufacture of

(1) This group includes : The Delta Steel Mills, The National Co. for Metal Industries Co. and the Copper Works.

steel from scrap and then rolling it into finished steel products such as reinforced concrete bars. The third group includes the Egyptian Iron and Steel Co. (which will be integrated into the new iron and steel complex).

This company and also the complex are highly vertically integrated especially backwardly. Their activities include the first six production processes in the table above, except the manufacture of coke.

However, the gradual creation of the iron and steel industry, as mentioned above, is natural and suitable for a developing country, like Egypt. It is costly and uneconomic to start the iron and steel industry by creating at once a fully integrated plant, for the following reasons :

First, the capital requirements for mine, blast furnaces, steel converters, and rolling mills, are substantial and beyond the means of many developing countries. Secondly, the scarcity of skilled labour during the early history of the industry. So it is unwise to distribute the small number of available skilled labour thinly on the various stages of production. Thirdly, the market for the various steel products is small at the beginning. It gets bigger under the pace of industrialization.

9 — LOCATION

All steel factories — except the plant of the Copper Co. — are located in the neighbourhood of Cairo. Moreover, the large complex is being built in Helwan, a suburb 24 Km. south of Cairo, where the plants of the Egyptian Iron and Steel Co. are located. So we may say that the iron and steel industry and its extensions are highly concentrated in the Greater Cairo area. It is only the Copper Co. which is located in the port of Alexandria. The merits of these two locations will be examined.

A location near Cairo has the following advantages :

- 1 — Most of the industries using iron and steel products are heavily concentrated in the Cairo area. So the final steel products, which are mostly coming from the

Egyptian Iron and Steel Co., are consumed by processors a few kilometres away.

- 2—A location near Cairo is favoured for its proximity to the labour market, where the nucleus of skilled labour and professional cadres is found.
- 3—Raw materials : The basic raw materials are coal, iron ore and scrap. The first is imported via the port of Alexandria. Coal, until now, is carried by railways from Alexandria 200 Km. to the north to the coke company in Helwan.

By 1975, coal coming from Alexandria will be carried by the Nile. This will certainly help in reducing the cost of transport of coal and the cost of coke in the last analysis. Moreover, the use of water transport will reduce the pressure on the congested railways, and make use of a cheap means of transport so far neglected.

Iron ore has been drawn from the Aswan mine, 800 Km. south of Cairo. By the end of 1973, the existing blast furnaces together with the new ones, depend on iron ore from the Baharya mine, 300 Km. south-west of Cairo. The new mine has the following advantages :

- a) higher iron content ;
- b) lower proportion of harmful impurities; and
- c) nearness to the iron and steel factories.

Most of the scrap in Egypt is concentrated in the Cairo area. Yet its supply is not sufficient for the needs of the big users of scrap such as the Delta Co. and the National Co. for Metal Products. These companies depend on scrap for their electric furnaces. They complain from the shortage of local scrap, and have to supplement their requirements through imports. The Egyptian Iron and Steel Co. depends on scrap collected from the rolling mills. It sells the surplus to other users.

From the above, we come to the conclusion that the location of the plants of the Egyptian Iron and Steel Company in Helwan,

near Cairo, is favourable in many respects. This is contrary to the criticism which was raised during the fifties, when Helwan was chosen as a place for the new plants. The critics wanted the plants to be located in Aswan besides the ore mine.

This location is unfavourable for the following factors :

- 1 — Aswan is 1000 Km. away from the port of Alexandria where coal and other materials are imported.
- 2 — The market for steel is mostly in the Delta, where the industries — old and new — are concentrated especially in Cairo and around it. Moreover, it is cheaper to transport iron ore from Aswan to Cairo than to transport final steel products.
- 3 — The bulk of the skilled labour and professional persons is concentrated in the Delta. It is costly and troublesome to drag a large number of people to work in the Aswan area.⁽¹⁾

It is economically and socially desirable to move industry to labour and not the vice versa.

- 4 — The iron and steel industry depends for its power on oil, gas, electricity and coal. All these sources of energy, except electricity, can be easily obtained from a location near Cairo. Hydro-electricity from the Aswan High Dam is transmitted to Cairo and Alexandria. So the iron and steel plants located in Cairo or Alexandria can get their requirements of electric power transmitted from Aswan. Moreover, the complex will also depend on natural gas discovered in the north of the Delta.
- 5 — If a location in Aswan had been chosen — just because the ore was there — it would have been impossible to use the better Baharya ores (300 Km. south-west of Cairo).

(1) The large fertilizer plant (KIMA) in Aswan is facing similar problems. The workers get higher wages and other benefits including cheap accomodation and free travel to Cairo. But they complain of being far away from their homes in the north of the country.

The plant would have continued to use the poor ores of Aswan.

Now we must conclude by a few words about the location of steel plants in Alexandria. This location is favourable for the same reasons as the location in Cairo. Besides, the ease with which exports of steel products can be made in the future.

Conclusions

The creation of the iron and the steel industry in Egypt is justified on several grounds. These include: employment, utilization of local raw materials, saving in foreign exchange, stimulation of other related industries, and finally the appearance of a host of external economies.

Production is highly concentrated in the hands of a few fairly large firms. The production units, at the different stages of production, are mostly small, with the resultant loss of the economies of large scale production. However, the new extensions, especially the iron and steel complex, will include larger production units in all stages of production. Moreover, the new extensions adopt new production techniques, which are likely to give higher yields and to help in reducing production costs.

Production costs are high, but are likely to fall as a result of the use of better iron ore, more modern techniques, and the production on larger scales. However, the mentioned decline in cost is not likely to take place, if production capacities are not fully utilized.

At present, pig iron and crude steel processes are fully utilized, while the rolling mills are operating with large margins of unused capacities. This is mostly due to shortage of steel. However, this problem is likely to be solved when the iron and steel complex is completed in the near future.

Although, the production capacity of pig iron and steel (crude and finished) is now being largely increased, there is no indication of any expected big margin of surplus capacity. This is due to the rapid increase in steel consumption. Moreover,

capacity should be designed to meet any growth in demand in the near future. Therefore, any excess capacity which is going to appear when the complex is completed, is likely to disappear a few years later. A new extension in production capacity will be necessary.

All iron and steel plants are concentrated near Cairo, except one in Alexandria. Their location is favourable. Nevertheless, Alexandria should be given a bigger share of any new steel plants to be erected in the future. Alexandria is favoured for the ease and economy in transport costs of steel exports, and imports of raw materials for the industry.

Statistical Appendix

Table 1

Percentage Distribution of Rolled Steel
Consumption in Developing Countries (1962-1964)

Country	Railways material	Heavy & light sections	Plates	Sheets	Tubes and fittings	Tin plate	Wire rods
Egypt	12	40	3	9	18	7	-
India	10	38	14	19	n.a.	4	-
Iran	-	46	3	17	26	2	-
Colombia	2	28	4	16	7	6	7
Iraq	3	69	3	9	10	3	-
Brazil	3	30	8	31	3	1	9
Venezuela	-	29	3	10	21	11	5

Source : The European Steel Market, ECE, Geneva, and Statistics of World Trade in Steel, ECE, Geneva (various years).

Quoted by E.C.E. "Iron and Steel Industries", Industrialization and Productivity, Bulletin No. 13, p. 81, table 13.

Table 2
Egypt-Apparent Consumption of Steel
 (Expressed in terms of crude steel)
 (Thousand metric tons)

Year	Total	Per capita Kg.
1950-52 (average)	260	12.6
1953-55 "	275	12.2
1956-58 "	231	9.7
1958	243	10.0
1959	217	8.6
1960	326	30
1958-60 (average)	262	16.2
1961	373	14
1962	474	13
1963	439	16
1964	693	24
1965	791	27
1961-65 (average)	554	19
1966	825	27
1967	758	25
1968	665	21
1969	702	22
1970	921	28
1966-70 (average)	774	24.6

Source : U.N., Statistical Yearbook (various issues).

Table 3
Certain Iron & Steel Companies Working in
Egypt in 1970

Company and plant	First year of production	Blast Furnaces		Steel converters		
		No.	Capacity ton/day	No.	Type	Capacity (ton)
1. The Iron and Steel Co.	1958	1	400	2	Electric	12
	1960	1	400			
	1958	}		4	Thomas	17
	1966					
2. The National Metal Industries Co.	1949			1	Simens-Martin	25
	1965			1	Simens-Martin	35
3. The Delta Steel Mills	1947			2	Electric	3
	1953			1	"	12
	1956			1	"	18
	1970			1	"	25
1. The Egyptian Copper Works	1953			2	Simens - Martin	25
	1970			1	Simens-Martin	50
	1970			1	Electric	25
	1970			1	Electric	5

Source : IDGAS, A Study on the Iron & Steel Industry in the Arab States, Cairo, 1970, chapter 2, pp. 7-8.

Table 4
Production : Pig Iron, Crude Steel and
The main Steel Products (thousand metric tons)

Year	Pig iron	Crude steel (1) ingots	Wire rods	The main steel-products		
				plates (2)	Railway materials(3)	Plain wire
1958	34	28	n.a.	n.a.	n.a.	n.a.
1959	117	112	130	16	28	6
1960	143	136	160	25	32	7
1961	174	156	176	31	25	7
1962	176	188	189	33	41	8
1963	205	194	197	29	48	8
1964	192	177	187	35	66	6
1965	200	179	162	29	94	12
1966	215	195	176	37	110	13
1967	220	200	176	60	132	12
1968	220	190	203	42	155	10
1969	300	190	213	45	148	11
1970	300	227	n.a.	41	n.a.	13

Sources : U.N., Statistical Yearbook (several editions) and U.N., The Growth of World Industry, Vol. II, (several editions).

(1) Crude steel includes crude steel for casting.

(2) Medium 3 to 4.75 mm and heavy plates over 4.75 mm.

(3) Including light and heavy sections.

Table 5
Production Cost of Finished Steel for Different
Scales of Production, Latin America
(1948 U.S. Dollars)

Components of cost per ton	Capacity of plant (thousand metric tons a year)							
	50		250		500		1,000	
	Dollars	%	Dollars	%	Dollars	%	Dollars	%
Raw materials	33.84	16	31.26	19	31.26	23	25.68	20
Labour	32.00	15	15.20	10	8.57	5	6.60	8
Capital charges	122.93	59	101.20	64	87.10	65	85.05	67
Maintenance and Miscellaneous	20.59	10	11.11	7	10.57	7	9.83	5
Total cost	209.36	100	158.77	100	137.50	100	127.16	100
Total investment Per ton	492		405		348		340	

Source : U.N., Economic Commission for Asia and far East, Formulating Industrial Development, Programmes, p. 44. Quoted by U.N., Productivity and Industrialization, Bulletin No. 8, 1964, p. 61.

Table 6
The Rate of Unused Capacity in the Iron and
Steel Industry in Egypt (1970)
(thousand metric tons a year)

Production Department	Capacity	Production	Unused capacity
	1	2	3
Blooms	320	190	40
Slabs	50	15	70
Heavy sections	112	60	47
Light sections	80	52	35
Plates and sheets	57	52	8
Strips	300	100	67
Tin-plate	45	30	34

Sources : 1) Industrial Development Centre for Arab States (IDCAS), A Study of the Iron and Steel Industry in the Arab States, Cairo, 1970, chapter 2, p. 24 (in Arabic).
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