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THE MANUFACTURE OF BASIC INDUSTRIAL EQUIPMENT IN ARGENTINA

IV. Iron and steel production

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THE MANUFACTURE OF BASIC INDUSTRIAL EQUIPMENT IN ARGENTINA

IV

IRON AND STEEL PRODUCTION

Summary and conclusions

In order to weigh the prospects for domestic manufacture of the equipment required for the expansion of the steel-making industry up to 1970, potential demand for rolled steel products and pig iron in that year was first estimated, by the methods described in detail in section 1. The result obtained - 650 000 tons of pig iron for use in privately-owned foundries and steel mills and 3 million tons of rolled steel products (bars, shapes, wire, sheet, tinplate, etc.) - represents an increase over consumption in 1960 amounting to 225 per cent in the case of pig iron, and 100 per cent in that of rolled products.

The expansion of Argentina's iron and steel production in order to cope economically with this additional demand may be planned in different ways, each having advantages and drawbacks that depend upon a series of factors, including government policy. A thorough study of the various solutions suggested in this connexion in the Republic of Argentina during recent years would have to be based on technical data that were not available, and on a careful analysis that is beyond the scope of the present study.

A reasonable basis for an estimate of demand for equipment would be to start out from the assumption that the above-mentioned solutions should be essentially in line with one or other of two main alternatives - the establishment of new integrated mills of medium size and the enlargement of a number of small semi-integrated mills, or the rapid expansion of the San Nicolás integrated mill. The latter procedure would entail the installation of new plant or the expansion of existing facilities only as far as required to supplement the output of the country's leading steel mill in respect of certain types of rolled steel products.

/The many

The many possible variants on the first alternative have been the subject of exhaustive debate on a number of occasions. However, the analysis of the problem needs to be completed with the discussion of the second of the solutions referred to, i.e., the possible expansion of San Nicolás; this, as will be seen later, is apparently already under way as regards the steel-making section.

The programme for the expansion of steel making presented here is therefore based essentially on the rapid enlargement of the San Nicolás mill in such a way as to ensure the maximum return on the substantial investment effected. Under this programme, by 1970 the output of rolled steel products would exceed 90 per cent of the consumption predictable for that date. Imports would consist of highly-specialized rolled products, whose manufacture in Argentina is inadvisable in view of the heavy investment in equipment required, and the limited size of the market.

By 1970, approximately 50 per cent of the steel billet needed for the existing private industry would be supplied by the San Nicolás plant; the other 50 per cent would be produced by the consumers themselves, their present installed capacity (230 000 tons) being raised to 530 000 tons of steel ingots. To this end, more open hearth furnaces would have to be installed, and advantage would have to be taken of the prospect of low world market prices for scrap - if local supplies were insufficient - and of the domestically-produced furnace fuel available.

Domestic industry seems to offer no solution to the problem of pig iron for the use of privately-owned foundries and steel mills, whose annual requirements, according to estimates, would be 650 000 tons by 1970. Argentina does not yet possess the facilities it would need to produce pig iron at a reasonable price in order to obtain steel intended solely for the manufacture of billet, given the low price of the latter on the world market. It is therefore assumed that a high percentage of pig iron would be imported.

/An endeavour

An endeavour was made to work out a possible breakdown of demand by flat products (plate, sheet, strip, etc.) and non-flats (bars, shapes, wire, etc.) in order to determine the equipment required to increase output. The estimated value of the main equipment for the implementation of the plan proposed amounts to 116.5 million dollars, at current prices. It may be roughly calculated that domestic industry is in a position to manufacture 45 per cent of this equipment, which represents the equivalent of 52.5 million dollars.

While it is true that the country has by this time the requisite experience to manufacture equipment on such a scale, a different situation prevails with respect to design, with the result that the engineering services of foreign firms would have to be called in. Technical standards for the domestic manufacture of the equipment concerned would not constitute a major problem, since Argentina has experience in the formulation of standards and personnel qualified for the task.

While it is true, however, that domestic industry would be technically capable of manufacturing the percentage of equipment assigned to it, there would remain the serious limitation deriving from long-term financing. Such financing is absolutely indispensable for the purchase of steel-making equipment, so that the limited amount of internal credit available can be used for assembling plant and putting it into operation. It must be borne in mind that in present conditions in Latin America, these processes involve investment amounting to about twice the value of the equipment for new mills, and 100 per cent of its value in the case of the expansion of mills already in existence.

Allowance would also have to be made for the possibility that a high percentage of the equipment required for the expansion of Siderúrgica Campana S.A. (SIDERCA) and the mills manufacturing special steels would come from abroad, in the shape of a capital contribution from foreign firms.

/1. Projections of

1. Projections of demand for steel products

In the ECLA study entitled El desarrollo económico de la Argentina,[1] consumption of steel products by 1967 was estimated in relation to a possible increase in the gross product of the economy.

Despite the fact that in the early years of the period under consideration the gross product has not registered the increments assumed in the above-mentioned study, it is thought advisable to keep to the figure then calculated for consumption of steel products, since the question is rather one of forecasting medium-term consumption trends, which may of course differ from actual consumption in specific years. Again, it has been noted that steel consumption in Argentina is characterized by the existence of a repressed demand which would find expression in real consumption as local production or the capacity to import increased. For the purposes of the present study, therefore, it seems best to adopt the estimates of steel consumption previously prepared by ECLA.

Since the limit now established is the year 1970, the figures cited in El desarrollo económico de la Argentina were extrapolated to obtain estimates of consumption of rolled steel products and pig iron in that year. This gave a total of 3.65 million tons, broken down as follows: 3 million tons of rolled steel products - bars, shapes, wire, sheet, tinplate, etc. - and 650 000 tons of pig iron for use in the foundries and steel mills belonging to the private industry.[2]

The foregoing figures represent an increase over consumption in 1960 amounting to 100 per cent in the case of rolled products and 225 per cent in that of pig iron. The higher percentage for pig iron is explained by the fact that the manufacture of industrial machinery and equipment is expected to develop substantially, with the consequent demand for large quantities of castings.

1/ E/CN.12/429/Add.1 and 2/Rev.1, United Nations Publication, Sales No.: 59.II.G.3, Vol. II, pp. 171 et seq.

2/ In steel mills pig iron and scrap are used to feed the open hearth furnaces. On the assumption that the proportion of pig iron is 30 per cent, by 1970 this sector's total annual consumption would be roughly 160 000 tons, if the steel development plans set forth in the present study were adopted.

/In order

In order to draw up a programme for the expansion of steel making which will make maximum use of the country's existing installed capacity, something must be known of the possible breakdown of consumption in and around 1970 by flat products (plate, sheet, strip, etc.) and non-flats (bars, shapes, wire, etc.). The increased use of durable consumer goods such as passenger-cars, refrigerators, washing-machines, etc. is reflected in a corresponding increase in demand for flat steel products, which thus becomes an indicator of the level of living of the population. The country with the highest index of consumption of flats is the United States (55 per cent). Next, although some distance behind, come the United Kingdom (46 per cent) and the Federal Republic of Germany (44 per cent). In Argentina the percentage share of flats in total consumption of rolled steel products has risen rapidly. In the three-year period 1946-48 it was 35 per cent, and by 1958-60 it had reached about 40 per cent.

To determine the possible increase in this percentage by 1970, correlations with the development of certain macro-economic variables were prepared, but the resulting figures are unlikely to be attained, judging by the experience of the countries with the highest levels of living in the world. One explanation may lie in Argentina's low consumption of structural shapes, which tends to raise the percentage of flat products; this situation would change in the future if metal structures were used in building and heavy equipment for industry were manufactured. Consequently, it seemed a reasonable working hypothesis to assume that by 1970 the index of consumption of flats would be 44 per cent, which is the current figure in the Federal Republic of Germany.

On the basis of the preceding estimates, consumption of rolled products by 1970 might be broken down by 1.3 million tons of flats and 1.7 million tons of non-flats.

/This classification

This classification by flat and non-flat rolled products is of great importance in programming for the iron and steel industry, because the manufacture of flats entails heavier investment per ton of output and larger-scale production than that of non-flats. Nevertheless, the manufacture of flats is the more profitable, since it is the branch of the iron and steel industry in which the greatest technological advances in steel rolling have been developed, with the result that its productivity has been considerably increased. Hence the striking prospects held out by the expansion programme under discussion for the San Nicolás steel mill, whose rolling equipment for flat products has the highest productivity of any at present installed in Latin America.

2. Consumption and present production capacity

Notwithstanding the restrictions imposed on imports by the shortage of foreign exchange, consumption of rolled steel products and of pig iron for foundries shows a rising trend, except in the period 1952-54, when it was considerably reduced by a serious foreign exchange crisis.

In table 1, the annual average for each three-year period is presented, in order to give a more accurate idea of the growth of consumption, by diffusing the influence of the greater or lesser import facilities that may have existed in specific years. The table also indicates the share contributed by domestic production. As regards pig iron, the domestic industry's contribution is attributable to the Zapla plant and latterly also to the San Nicolás mill. The situation will be different when both mills enter integrated operation, since thenceforward all their pig iron will have to be used for steel making, as a matter of economic expediency. The heavy investment required for the plant installed at Zapla and San Nicolás will compel these mills to base their manufacturing plans on the products that bring in the highest profits.

/Table 1

Table 1

ARGENTINA: DISTRIBUTION OF CONSUMPTION OF IRON AND STEEL PRODUCTS BETWEEN DOMESTIC PRODUCTION AND IMPORTS, 1946-60

(Annual averages expressed in thousands of tons)

Three-year period	Pig iron			Rolled steel products		
	Domestic production	Imports	Total	Domestic production	Imports	Total
1946-48	..	89	89	147	643	190
1949-51	..	84	84	258	713	971
1952-54	35	30	65	365	413	778
1955-57	32	123	155	656	615	1 271
1958-60	42	121	163	820	737	1 557
	Percentage distribution					
1946-48	..	100	100	19	81	100
1949-51	..	100	100	27	73	100
1952-54	54	46	100	47	53	100
1955-57	21	79	100	52	43	100
1958-60	26	74	100	53	47	100

So far there does not seem to be any economic way of producing pig iron of the quality required by the modern metal transforming industry. The reason lies in the low world market price of pig iron, which means that its production must be left in the hands of those countries which have really abundant supplies of iron ore and fuel and can therefore obtain it at a low cost. If the requisite conditions for manufacturing this product were not to be found in Argentina in the future, it would apparently continue to be imported.

/Table 1

Table 1 also shows how small is the share of domestic production in satisfying consumption of rolled steel products. Yet the country's dependence on imports to meet its requirements in this respect is greater than might be deduced from the figures in the table, since a substantial proportion of domestic output is manufactured in rolling mills on the basis of imported billet.

Imports of rolled products take two principal forms: rolled products which find their way directly to the consumer market, and semi-manufactured products (billet) for subsequent re-rolling.

In the last of the three-year periods under consideration, imported rolled steel products supplied 87 per cent of consumer requirements; this total was made up of 57 per cent of rolled products, and 43 per cent of semi-manufactured products which were sent to be re-rolled and made into bars.[3/] It should be stressed that re-rolling is done in the case of products with a lower commercial value, while imports are confined to the higher-priced goods, which greatly adds to foreign exchange spending.

At present, rolled steel products are manufactured by several establishments grouped together in two large organizations, which are referred to in the present study as "the private industry".

One of these groups, the Centro de Industriales Siderúrgicos (CIS) is formed by semi-integrated plants which melt scrap and a low percentage of pig iron in open hearth furnaces and produce a type of steel ingot suitable for their rolling equipment. Production of these ingots - averaging 230 000 tons annually during the last three-year period - accounted for 38 per cent of the group's total output of rolled products (a little over 500 000 tons per annum). For the remainder, imported billet is used.

Another group is the Centro de Laminadores Industriales Metalúrgicos Argentinos (CLIMA), whose members possess only rolling equipment. Their output (averaging about 280 000 tons per annum over the last of the three-year periods considered) is based entirely on imported billet.

3/ According to the definition of bars as given in the ASTM standards.

The joint steel rolling capacity of the two groups amounts to some 900 000 tons yearly, but their actual output depends upon current facilities for importing billet. Owing to the difficulties resulting from foreign exchange shortages, the annual output of the steel re-rolling sector has fluctuated in recent years between 700 000 and 850 000 tons of bars.

Table 2 shows how marked is the dependence of private industry upon imports.

Table 2

ARGENTINA: PRODUCTION AND IMPORTS OF FINISHED ROLLED STEEL PRODUCTS, 1946-60

(Annual averages expressed in thousands of tons)

Three-year period	Steel ingots (Output of CIS group)	Finished rolled steel products		
		Output of CIS and CLIMA groups	Imports[a]	Total
1946-48	127	147	643	790
1949-51	129	258	713	971
1952-54	162	365	413	778
1955-57	214	656	615	1 271
1958-60	230	820	737	1 557

Source: Data provided by CIS and CLIMA, and foreign trade year-books.

a/ Excluding imports of billet to be used for the manufacture of rolled products.

The second column indicates the slow growth of production of steel ingots for rolling. Apparently producers find little incentive to develop this line of manufacture, and therefore prefer to use imported billet.

This dependence upon imports of billet raises the problem of their replacement by domestic production. A possible solution is suggested below.

3. Immediate production prospects

On the basis of the projection of demand up to 1970, probable consumption of rolled steel products in 1965 is estimated, by interpolation, at 2.35 million tons. Under the programme set forth below, the annual production figure for the period 1958-60 (820 000 tons) would increase to 1.62 million tons by 1965, thus covering 69 per cent of Argentina's estimated requirements for that year. Nevertheless, this output would still be only partly based on domestically-produced ingots. If rolled steel products manufactured from imported billet are excluded from the above-mentioned figure, the proportion of consumption satisfied by domestic production drops to 920 000 tons (39 per cent of the total). Probably the only way of dispensing with imports of billet in 1965-70 would be through the addition of a few open hearth furnaces in the privately-owned works, and a larger-scale expansion of the San Nicolás mill which would enable it to supply the private industry with billet for re-rolling.

The first stage of this expansion would consist in the installation of a fifth open hearth furnace, which was already contemplated when the furnace bay of the existing steel works was projected. At the same time, an oxygen plant would be installed to increase the yield in the works in question, so that a better balance might be achieved between steel-making and rolling capacity.

Certain products manufactured by the San Nicolás mill are already on the market, and it is hoped that 1962 will witness the completion of the installations for the first programme contemplated - the manufacture of 630 000 tons of steel ingots for conversion into about 480 000 tons of rolled products.

It was also planned to complete the Zapla mill integration project in 1962, with a view to operation on the basis of local raw materials and fuels. So far this plant has been producing only pig iron, and for the purposes of integration a steel plant and the corresponding rolling equipment are in process of assembly. Its production capacity is likely to be about 120 000 tons of rolled steel products (bars for consumption in the north of Argentina).

/Progress is

Progress is being made in the construction of Siderúrgica Campana S.A. (SIDERCA), a semi-integrated mill which will melt scrap in electric furnaces. During the initial phase, the steel produced will probably be used for the manufacture of about 120 000 tons of seamless tubes yearly. There is an expansion project under which the plant would be converted into an integrated mill by the installation of rolling equipment. It would then turn over mainly to the manufacture of special steels.

A characteristic feature of the iron and steel industry is constituted by the initial operational problems connected with the synchronization of the various sections of an integrated mill in order to obtain a high yield. These difficulties relate chiefly to the complexity of the installations and to the training of personnel. As a rule, the process of putting the whole plant into operation takes several years, but in the case of San Nicolás it might be completed in a short time, since the various sections have gone into operation by gradual degrees, which has made for a more thorough knowledge of their workings.

Hence, 1965 seems likely to be the year in which the rated output of the steel-making projects in course of execution should begin to find its way on to the market. Table 3 presents a breakdown of this output for the year in question.

Table 3

ARGENTINA: BREAKDOWN OF OUTPUT OF ROLLED STEEL PRODUCTS, 1965

(Thousands of tons)

Industrial establishments	Steel ingots	Finished rolled products[a]	
		On the basis of domestically-produced ingots	On the basis of imported billet
San Nicolás	630	480	...
Existing private industry	230	200	700
SIDERCA	150	120	...
Zapla	150	120	...
Total	1 160	920	700

a/ The coefficients for conversion of steel ingots to rolled products differ according to whether the establishments concerned are integrated mills or semi-integrated plants without blooming mills, on account of the size of the ingot produced. In the former case, the figure ranges from 120 to 135 kilogrammes of steel ingots per hundred kilogrammes of rolled products and in the latter from 110 to 120 kilogrammes.

/4. Longer-term

4. Longer-term prospects

If only 39 per cent of consumption will be satisfied in 1965 by domestic production (excluding output obtained by the mere re-rolling of imported billet), the inference is that the expansion effort must be sufficiently intensified in the next few years for consumption of about 3 million tons to be possible in 1970 without entailing the very heavy foreign exchange expenditure that would be involved if production were allowed to remain at its 1965 level. Moreover, the prospects for steel making in Latin America up to 1970, with due allowance for existing expansion plans, show a deficit of about 5 million tons in respect of rolled steel products, which means that imports of such items to meet Argentina's consumer requirements would have to come from outside the region.

It is perfectly conceivable, however, that in 1970 domestic production of rolled steel products might contribute over 90 per cent of consumer requirements, and, what is more, on the basis of lower investment than has been so far effected in the San Nicolás mill. The explanation lies in the improvements recently introduced in the steel-making process; if these were applied at San Nicolás its yield could be increased considerably.

The blast furnace, which represents the classic steel-making process, is exposed to competition from a large number of newly-discovered procedures that are jeopardizing its supremacy inasmuch as they strike at two weak points in the traditional process, namely, the heavy investment per ton of annual output which the installation of the blast furnace implies, and the special characteristics which the raw materials must display if a high yield is to be obtained.

Accordingly, detailed studies of the blast furnace process have been carried out, with remarkable short-term results, enabling rated capacity to be doubled already. The equipment installed was designed with this end in view, and the investment involved was only 40 per cent of what it would cost to assemble a new blast furnace.

Agglomeration of the furnace charge, injection of air at higher pressures and temperatures and standardization of the operation are responsible for this extraordinary achievement. The system of injecting liquid and gaseous fuels is now being perfected in order to reduce consumption of coke and increase the yield of the furnace, with highly promising results.4/

At the same time, similar circumstances have led to the discovery of procedures which, while entailing only modest investment, considerably improve the steel making yield of open hearth furnaces. Outstanding among these is the use of oxygen to accelerate the process of converting pig iron into steel. The projected application of these new techniques at San Nicolás would significantly increase the volume of steel produced, and would enable the surplus capacity of the existing rolling-mills to be utilized, and reduce costs accordingly.

At a later stage, another production increment would be obtained by the addition of further independent items of equipment, such as another blast furnace with its accessories, a steel plant, and rolling-mill units to cope with the increase in the output of steel.

By these means, pig iron production in two blast furnaces would be boosted to an annual figure of 1.7 million tons; this output would be used for the existing open hearth furnace in the same mill - its operation speeded up by the use of oxygen - and for a new steel plant in which the oxygen-blown converter process would be applied, on account of the desirability of aiming at the lowest investment per ton of output compatible with maintenance of the quality of the steel produced.

The total output of steel at San Nicolás would thus reach 2.4 million tons. Half of this would correspond to the open hearth installations, and the other half to the new converter-type plant.

4/ The injection of some 75 cubic metres of natural gas per ton of pig iron produced means a saving of about 10 per cent on coke consumption. The Société des Aciéries de Pompey, in France, has carried out extremely important studies in this direction.

/When the

When the mill is in full production, the scrap obtained for recirculation will exceed 500 000 tons yearly. This should enable the open hearth furnace charges to be prepared with 60 per cent of pig iron and 40 per cent of scrap - a proportion greatly to be recommended when oxygen is used as an activator.

Manufacture of rolled steel products should be directed towards production of the largest possible quantity of flats, because of their higher commercial value and because, as a result, they are more profitable for the establishment concerned. With the new rolling equipment at the San Nicolás mill it should be possible to produce an annual output of 1.4 million tons of finished rolled products, plus 460 000 tons of billet. The latter would be sold to the existing private industry. The finished rolled products would consist of 1.15 million tons of flats and 250 000 tons of rails and shapes.

At the beginning of the present discussion it was postulated that by 1970 a possible breakdown of consumption of finished rolled steel products might be 44 per cent of flats and 56 per cent of non-flats, which would be equivalent - in accordance with the consumption figures adopted here - to 1.3 and 1.7 million tons, respectively.

The San Nicolás mill would manufacture 88 per cent of the total output of flat steel products, i.e., 1.15 million tons per annum; the remainder (150 000 tons) would have to be imported, since they would be highly specialized products for which demand is relatively limited in relation to the investment required for their production. Cases in point are very wide sheet and plate for the automobile industry and for shipbuilding, as well as thin silicon-steel sheets for electrical equipment. The same argument holds good for certain non-flats, such as shapes of large dimensions and unusual design, and for a variety of special steels, which in the aggregate would represent about 50 000 tons of imports.

As regards non-flats, the San Nicolás mill would make an annual contribution of 250 000 tons of rails and shapes. The remainder would be covered by the other plants, to which San Nicolás would deliver 460 000 tons of billet.

/Table 4

Table 4 indicates the increments which would have to be achieved by the various industrial establishments in order to implement the programme drawn up here.

Table 4

ARGENTINA: OUTPUT OF FINISHED ROLLED STEEL PRODUCTS, 1965 AND 1970

(Thousands of tons)

Industrial establishments	Output in 1965		Output in 1970
	On the basis of domestically-produced ingots	On the basis of imported billet	
San Nicolás	480	-	1 400[a/]
Private industry	200	700	900
SIDERCA	120	-	260
Plants making special steels	-	-	120
Zapla	120	-	120
Total	920	700	2 800

a/ Plus 460 000 tons of billet for re-rolling by the private industry.

Between 1965 and 1970 the existing private industry would have to raise its annual output of finished rolled products from 200 000 to 900 000 tons. To this end, it would have to increase its output of billet from the present figure (230 000 tons) to 530 000 tons; this volume, together with the 460 000 tons produced at the San Nicolás mill, would give a yearly total of 990 000 tons of billet, from which the requisite 900 000 tons of finished rolled products would be obtained.

Such an expansion of the private industry, designed to supply most of the raw material required to put existing rolling equipment into full operation, would necessitate the addition of a few open hearth

/furnaces to

furnaces to be charged with scrap. This would not involve very heavy investment, and the relatively low productivity of the small furnaces would be adequately offset by the advantages that would derive both from the more efficient utilization of installed rolling capacity, and from the fact that this sector of the industry would then be practically independent of imports of its raw material (billet).

The projected expansion of SIDERCA would raise its output to 260 000 tons(see again table 4). In this connexion, study is being devoted to the possibilities of applying some of the procedures known as direct reduction - straight from ore to steel - in order to supersede the use of scrap in the electric furnaces.

The table further includes an output of 120 000 tons of special steels, corresponding to several existing projects. Although these projects are still in the embryonic stage, it may be assumed, in view of market requirements that by 1970 plants concentrating entirely on the manufacture of special steels are bound to exist in Argentina.

Scrap would be of preponderant importance, since it would be the raw material required for SIDERCA's semi-integrated plants and for special steels, as well as for the expansion of private industry. However, in view of the tendency in world steel production to make greater use of oxygen-blown converters - which absorb less scrap than the open hearth process, hitherto the most widely used - demand for scrap on the world market would be proportionally less, which encourages the hope that its price would remain low. Moreover, the latest advances suggest that in the manufacture of quality steels higher productivity is ensured if scrap is replaced in oxygen-blown converters by high-grade iron ore, on account of the latter's uniform composition and greater ease of manipulation in the plant. This procedure will probably be applied in the new steel works at the San Nicolás mill - programmed as they are with converters of the type in question - so as to take advantage of the excellent quality of the ores imported from Brazil. Thus the plant could use the whole of its scrap for recirculation in the open hearth furnace charges.

/If requirements

If requirements of scrap for the expansion of the existing private industry are added to the amount needed for SIDERCA and for special steels - on the basis of furnace charges comprising 30 per cent of pig iron and 70 per cent of scrap - we get an annual figure of 700 000 tons. Of this, 100 000 tons would be recirculation scrap, and the balance (600 000 tons) would have to be purchased on the market.

Studies carried out in Argentina on the potential supply of scrap suggest that by 1970 it would be possible to collect the 600 000 tons of scrap required. Failing this, part of it would have to be imported, but that would present no major difficulties, as can be seen from the previous remarks on demand for scrap.

5. Equipment required for the steel industry's expansion programme, 1965-70

The preceding sections constitute an outline of an expansion programme for the iron and steel industry during the coming decade. Production increments up to 1965 should be obtained mainly by putting into operation, completely and on integrated lines, the equipment already in existence at the San Nicolás mill or at present in course of installation.

In view of the time required for the preparation of the final project and for the design, construction and assembly of the equipment, in particular, the several years that it takes to adjust the new installations so that their rated yield is attained, the work of expansion should be begun at the earliest possible moment. Only in this way can the capacity proposed here for the San Nicolás mill be achieved by 1970.

A programme for putting this expansion into effect has been studied with due regard to the equipment already purchased and installed and the need for total investment to be kept as low as possible.

/The expansion

The expansion programme would be implemented in two phases, starting at once. The execution of the first would mean spending relatively little time on the preparation of projects and designs and would considerably increase the yield of the existing installed capacity. The second would raise output to the levels contemplated for 1970, and its preparation and design would take longer, because most of the plant installed would be new and independent of the existing equipment.

The principal changes to be introduced in the first phase are indicated below. To begin with, output of coke would be increased by the addition of thirteen more ovens to the eighty-nine already in existence, giving fifty-one ovens to each of the batteries at present installed. A larger output of pig iron would be obtained by the installation of a sintering plant to deal with the raw materials used for the blast furnace charge, and also by modification of the equipment installed so that the air required by the furnace could be injected at higher pressures and temperatures. The means of achieving the steel production increment would comprise the installation of a fifth open hearth furnace and the use of oxygen for these furnaces to speed up the process. In order to raise output of finished rolled products, more pit furnaces would have to be installed for the blooming-mill, and another furnace for heating slabs constructed; certain changes would also need to be introduced in the auxiliary installations for manipulation of raw materials, power distribution, etc.

The equipment needed for this first phase could be designed, constructed and assembled in a period of not more than two years. During this time work would proceed on the studies, designs and construction for the second phase, which would take about four years more to reach full capacity.

The following would be the most important equipment for the second phase: a blast furnace to produce 850 000 tons of pig iron yearly, also operating on the basis of sinter, which would mean enlarging the sintering plant already purchased; complete facilities for coking and by-products to supply the coke requirements of the new

/furnace, plus

furnace, plus the coke needed to raise the annual output of the first furnace from 700 000 to 850 000 tons, so that the two furnaces would be operating at the same level of production; and a new steel plant operated by oxygen-blown converters, (for this the capacity of the oxygen plant installed during the first phase would have to be increased).

For steel-rolling purposes a new blooming-mill would have to be installed, designed solely for flat steel products and equipped with the corresponding pit furnaces and other accessories, as well as a new rolling-mill for plate and some supplementary plant. During the second phase, investment in auxiliary equipment would be fairly heavy in respect of power, steam, internal transport, etc.

Table 5 presents an estimate, at current prices, of the value of the principal equipment needed to expand the annual capacity of the San Nicolás steel mill from 480 000 tons of rolled products to 1.4 million tons, plus 460 000 tons of billet. The figures for each section cover the equipment required for both phases.

Table 5

ARGENTINA: ESTIMATE OF COST OF PRINCIPAL EQUIPMENT REQUIRED FOR THE SAN NICOLAS EXPANSION PROGRAMME[a/]

	Millions of dollars
Coking	8
Sintering	6
Blast furnace	9
Oxygen plant	7
Converters for steel making and one open hearth furnace	11
Rolling-mill	32
Ancillary services	21
Total	94

a/ These figures, covering equipment only, were established on the basis of data furnished by purchasers of new plants.

/The expansion

The expansion of the present private industry's steel output for its own rolling-mills would be effected by about ten establishments, through the installation of the same number of open hearth furnaces, each with a capacity of 30 tons, and characterized by a double pouring runner to fill two ladles at once. This is advisable in order to speed up the casting of small ingots for rolling purposes, and thus dispense with the heavy investment represented by a blooming-mill.

The amount invested in the main equipment would be determined by the furnace and cranes. The value of a 30-ton furnace with its accessories is estimated at 400 000 dollars, which would give a total of 4 million dollars for furnaces. Investment in cranes, at 200 000 dollars per furnace, would total 2 million dollars. In short, the value of the principal equipment for the expansion of the private industry would be 6 million dollars.

Table 6 presents an estimate of the value of the most important equipment required for the expansion of SIDERCA's annual capacity from 130 000 to 260 000 tons of rolled products. As stated above, this plant may possibly enlarge its capacity on the basis of some of the direct reduction processes as an alternative to the use of scrap. Possibilities in this field are steadily increasing owing to the advances that are being made in some of the processes in question.

Table 6

ARGENTINA: ESTIMATE OF COST OF PRINCIPAL EQUIPMENT REQUIRED FOR THE EXPANSION OF SIDERCA

	Thousands of dollars
Steel works	
Electric furnaces	800
Cranes	300
Rolling equipment	
Furnaces	250
Rolling-mill	1 700
Cranes	150
Electrical equipment	300
Total	3 500

/There are

There are several projects afoot for the manufacture of special steels, but they have not yet materialized. As this sector must necessarily develop during the next few years, it is assumed for the purposes of the present study that four plants with a capacity of about 30 000 tons each will be installed. The argument in favour of four plants rather than a smaller number is that, according to the project, they will operate with electric furnaces - the system most to be recommended - and, owing to the power shortage, they will probably have to be established in different parts of the country.

The project envisages one section for special steel forgings and another for the rolling of bars. Steels for tools would be manufactured, steels for mechanical engineering, high-speed steels and stainless steels.

Table 7 shows an estimate of the cost of the principal equipment for a plant with an annual production capacity of 30 000 tons of special steels.

Table 7

ARGENTINA: ESTIMATE OF COST OF PRINCIPAL EQUIPMENT REQUIRED FOR A PLANT MANUFACTURING SPECIAL STEELS

	Thousands of dollars
Steel-making	
Electric furnaces and auxiliary equipment	600
Cranes	250
Annealing furnaces	150
Cleaning lathes	100
Forging	
Press, manipulator and heating furnaces	400
Hammers, heating furnaces and cranes	300
Rolling	
Furnaces	100
Rolling-mill	900
Cranes	150
Heat treatment	150
Electricity sub-station	250
Total	3 350

/Estimated costs

Estimated costs for the most important equipment to be used in the proposed programme for the expansion of steel making are summed up in table 8.

Table 8

ARGENTINA: SUMMARY OF COST OF EQUIPMENT REQUIRED FOR EXPANSION OF THE IRON AND STEEL INDUSTRY, 1965-70

	Millions of dollars
San Nicolás	94.0
The private industry	6.0
SIDERCA	3.5
Plants making special steels	13.0
Total	116.5

6. Domestic manufacture of equipment needed for the expansion of steel making

The slow development of Argentina's iron and steel industry limits the possible extent of the country's experience in the manufacture of the equipment needed for its expansion.

While it is true that the manufacture of such equipment does not present complex technical problems when the proper machine-tools are available, the over-all plant design does require a breadth of experience which apparently is non-existent in Argentina, for the simple reason that this is not one of its traditional lines of manufacture. Hence contracts would have to be arranged with foreign firms for the requisite engineering services.

There is a parallel need for technical standards in respect of the equipment to be constructed. No difficulties seem to arise in this connexion. Of all the Latin American countries, Argentina is the most advanced in regard to national standards; those applicable to steel-making equipment could readily be determined by the highly-qualified personnel available in this field.

/Since a

Since a high proportion of the facilities installed in a steel mill consists of metal structures, tubular products, and separate items such as electric motors, pumps, compressors, etc., a good deal of this equipment could presumably be made in Argentina, which already has experience in such lines of manufacture. A study of the possibilities suggested that the share of domestic manufacture might be estimated at 40 per cent of the equipment required for expansion in the case of the San Nicolás plant, 70 per cent in that of the private industry, and 65 per cent in respect of both SIDERCA and the plants manufacturing special steels. Hence the value of domestic output of steel-making equipment in 1965-70, given the existing installed capacity and the experience at present possessed by the metal-transforming industry, would amount to about 52.5 million dollars.

It should be noted that this percentage represents only the most important equipment. A steel mill requires many other accessories which could be manufactured in Argentina and would go to swell the figure cited.

Nevertheless, in the case of the expansion of the San Nicolás steel mill much depends upon the need to seek long-term financing for the purchase of its equipment, since the integrated iron and steel industry is further characterized by the fact that the highest percentage of total investment is used for installing the equipment and putting it into operation, not for acquiring it. Consequently, long-term financing must be sought abroad, and short-term financing for the assembly and operation of the plant within Argentina. This might have an adverse effect by precluding substantial domestic participation in the manufacture of equipment for the expansion of the San Nicolás mill.