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MANUFACTURE OF  
IRON-ORE MINING AND STEELMAKING EQUIPMENT  
IN LATIN AMERICA<sup>1/</sup>

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## S U M M A R Y

The present paper justifies manufacturing this type of heavy equipment in Latin America based on the great magnitude of investments required in iron-ore mining and steelmaking facilities, adversely affecting the balance of payments of the region owing to the high percentage of imported items; the fact the steel demand in Latin America by 1980 and the expansion plans required to meet it will entail an investment of the order of 6,000 million US dollars, which can hardly be financed with external resources alone; the multiplying effect of this investment on other sector of the economy; and reduction of maintenance problems arising from local production.

Current obstacles opposing increased construction of such items locally are examined, showing that they arise mainly from lack of detailed information on investments, deficient technical knowledge, particularly as regards project engineering, lack of financing for producing and marketing such equipment, and proving that there are no serious limitations stemming from industrial facilities in Latin America.

It is shown how the process may develop gradually, in order to overcome the obstacles mentioned and win the confidence of the users. Consequently, equipment in universal use will be made first, going on later to items of more restricted employment and ending by manufacturing specialized units. In order to protect local markets an interesting formula is presented, based on government

action to require certain percentages of local components to be met in each of the stages of the project (engineering, civil works, equipment, erection, and start-up), with a view to increasing the percentage in each successive project. Adoption of such a strategy would make it necessary to set up a team of experts endowed with sufficient authority and permanence to command the respect of local manufacturers, designers, research centres, financing sources, and project owners. The author stresses the importance of UNIDO aid in contributing experts who could initially compose such a group.

Lastly, the paper refers to conditions that should be met for manufacture of these items to proceed harmoniously.

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The present paper justifies manufacture of this equipment in Latin America, examines current obstacles against extending such activities, outlines the successive stages along which the manufacturing process may develop, and sets forth the conditions that should be met in order to allow this process to develop gradually.

## 1. JUSTIFICATION

1.1. Steelmaking and iron-ore mining facilities are characterized by the great magnitude of the investments required, the imported element being particularly notable, so that they weigh heavily on the country's foreign-currency expenditures. The region, in turn, suffers from a chronic lack of foreign currency for reasons that need not be entered into here. This situation has been the basic reason for developing its industry and at the present stage of development also demands the manufacture of heavy equipment. In certain countries there is concern over controlling external debts, thus contributing to further restriction of foreign-currency availability, and indirectly supporting the substitution of such units by others than can be produced locally.

1.2. In 1980 steel demand in Latin America is expected to reach over 44 million tons; to meet it, programmes for

expanding production capacity are planned for that year which - if fulfilled - would supply 37,250,000 tons. Such plans will involve a probable investment amounting to 6,000 million dollars between 1974 and 1980. The magnitude of this figure alone shows at least the difficulty - if not the impossibility - of securing external financing to cover a major portion of the investment.

1.3 It also points out that the region as a whole will have a market large enough to justify local manufacture of equipment that will allow construction of new plants and expansion of existing ones. It should not be overlooked that a major part of such equipment is of universal use, not restricted specifically to steel or iron-ore production. Overall demand, in such cases, will be even higher than the above figures show. Another criterion to be taken into account when evaluating the market is that production need not be restricted only to domestic consumption, but that in the longer run it will be necessary to face competition on the world market, as proved by many instances of industrial countries.

1.4 A significant reason for our governments to promote manufacture of such goods is the fact that this will allow utilization of the multiplying effect of this investment on other sectors of our economy, thus increasing employment levels.

1.5 Sufficient emphasis is not generally placed on maintenance problems arising from the fact that these heavy units are imported, owing to close dependence on overseas spares which, in addition to involving additional expenditures of foreign currency, submits the equipment to foreign currency

situations, political and military contingencies, and other circumstances that can be readily imagined.

## 2. OBSTACLES AGAINST LOCAL MANUFACTURE

2.1 As we stated earlier, there are good prospects in Latin America regarding demand of such equipment generally; in our countries, however, it is very difficult to make long-term estimates of specific items, as the investments of user sectors are not programmed either sufficiently ahead of time or in the necessary detail. This circumstance makes market estimates doubly difficult and hinders decisions for starting this type of manufacturing activity.

2.2 It should be pointed out as well that according to international experience very few countries can keep up their internal consumption in a sustained fashion, this being one of the reasons why machinery makers have turned very quickly to the international market.

2.3 Apart from market considerations it is well to discuss the status of production factors, from the human, financial, and industrial equipment angles. In connexion with human resources it is natural to feel that lack of experience has prevented creating technical ability compatible with manufacture of such goods, particularly insofar as project engineering is concerned. The absence of such knowledge coupled with the fact that design deficiencies will affect the entire useful life of the facilities - 25 years or more in the present case - has led to trust being placed only in manufacturers of proved



experience, who can show a list of successful past achievements. Obviously, this situation brings about a vicious circle decisively militating against the development of such specialized knowledge.

2.4 The financial side also presents serious difficulties owing to the fact that the industrial nations promote export of their engineering and plant through credits, while in Latin America sources of financing are, generally speaking, remarkably weak, thus precluding the possibility of supporting local manufacturers in the same degree. Fortunately, it is possible to resort to the international banks which have lately shown their good will to grant loans applicable to financing projects, after calling for international bids in which not only are local makers allowed to participate but they may be protected, furthermore, if their governments wishes it.

2.5 The industry in Latin America is not equipped to tackle constructing the wide range of equipment required by steelmaking and iron-ore mining; it presents no serious limitations, however, for making an important percentage of such units, provided they are suitably designed for prevailing conditions, as will be discussed later. The greatest limitations lie in the range of high-precision instruments required to make items such as large-diameter roller bearings, high-precision bearings, or to assemble some exceptionally sophisticated systems; machine-tools for very large parts; foundry furnaces for very heavy castings. Nevertheless, the decision to buy locally can very often overcome such difficulties if the design is based on the available equipment. Supply of materials for manufacturing heavy equipment presents no major

problems; it would be necessary to limit only certain types of refractories, alloy steels, electric conductors, and other items in which local manufacture is not justified.

### 3. STAGES IN MANUFACTURE

3.1 Owing to the complexities involved in making this type of equipment and the essential need to win the confidence of the purchasers, the process must develop gradually, so as to overcome the difficulties discussed above.

3.2 In the first place, when preparing plant projects for iron-ore mining and steelmaking, the components that may be made locally should be singled out, which requires that designers be familiar with the country's conditions as regards equipment and technical ability, so that the design may be based on them. The decision to manufacture locally together with this previous knowledge will mean, almost invariably, that the design should also be made in the purchasing country. Projects designed abroad would lead to adjustments not easily made because of the delay that they would entail in completing the project. In this connection, it is worth recalling that such delays greatly increase management, supervision, and starting costs. In turn, the savings in foreign currency expected from substituting steel imports are not generated, and a critical alteration may take place in the grace periods granted by financing institutions, while the periods of negative flow of money increase.

3.3 One interesting formula for increasing local manufacture of such goods is for Latin American governments

to require certain percentages of local components in each of the stages of the project for meeting civil works, equipment, erection, and so forth, taking into account the level of development in the country and how to increase that percentage in each successive project. Of course, such action should be aimed at all plants erected in the country and be studied and controlled by industrial development agencies. One justification for employing this method is the fact that in most cases the governments are precisely the ones to guarantee the international credits obtained, so that, in a sense, they are partners in the projects. Furthermore, the need has often been felt for an agency to act in addition as "watchdog" to prevent costs from rising excessively owing to the use of obsolete equipment, oversized dimensions, and other major reasons for increased costs of industrial plants in developing countries.

3.4 The foregoing would require setting up a technical team able to act permanently and with authority to command the respect of local manufacturers, designers, technological research centres, financing sources, and project owners. The technical level of such a team is essential and the importance of selection and training cannot be overemphasized. To begin activities, foreign professionals may be resorted to, at which stage the cooperation of UNIDO could be most important. One point requiring due consideration is the compensation that members of this technical team will receive, in view of their great responsibility, and the level at which they will operate, on an equal footing with professionals from industrial countries, and as one way of preventing their flight to other regions, as their mobility is naturally very great. A certain degree of transfer of these experts

to the plants they will have helped to design or to local engineering firms is expected; the important thing, however, is for them to remain in their own countries. Such a technical team should be composed of civil engineers with experience in moving materials, structures, foundations, etc.; mechanical engineers trained in plant design and layout, combustion, mechanical maintenance, materials handling, etc.; electrical engineers with experience in electrical maintenance, instrumentation, and similar techniques; economists able to deal with financial analysis, project evaluation, costs, etc. In time these professionals will surely group together according to specializations, so as to act in the various sectors that they will need to control, such as mining, steelmaking, chemical industries, transport, etc. A strategy for general development of equipment manufacture is outlined below, although some of the stages described have been accomplished already in certain countries of the region.

3.5 Equipment for general use. The advisability appears obvious of starting the process by making items that are used in different industrial sectors - thus having a wider market - and others whose specific features make them suitable for more repetitive demand. International experience - including Latin America - supports this view, and industrial development has started along these lines. This sector includes travelling cranes, conveyor belts, boilers, pumps and similar items. It is advisable to begin production of such units following designs and specifications obtained abroad; the need to adjust to local conditions, however, including steel quality, safety standards, voltage,

etc., will inevitably lead to developing a different design. At this point we must insist that such innovations should be taken into account from the very beginning, from the time the licences are negotiated, so that these developments on local engineering may be properly valued and a benefit arise from utilization of the new technology involved, ending in independence from the conditions under which the original technology was purchased. The licensors themselves are very often interested in purchasing this technology, as shown in a number of instances, particularly in Japan.

3.6 Equipment in more restricted use. Manufacture of such items would appear to be the logical step to follow the preceding one. Here we should single out first a group of items subject to wear and thus enjoying a permanent market. In such cases it is absolutely essential that mining and steelmaking companies demand to be supplied with blueprints and specifications, so that they can enjoy a certain degree of independence from the foreign manufacturer. Having these data in their possession they will be in a position to tackle their own production, either at home or in countries other than the regular supplier. Almost invariably such dependence from foreign manufacturers has later led to almost insuperable conditions. It is not infrequently found that the manufacturers in those countries shift to other operations or that, past a certain stage in their development, making the required item is no longer justified because, say, their plant scale has increased; then they order the item from other manufacturers and their customer's costs are correspondingly charged. The same category of restricted-use equipment also includes

concentration plants, blast furnaces, coke plants, steelworks, continuous casting, etc. In such cases the units involved are heavy and of high cost in any project; consequently they require examination in depth to weigh the possibilities of making the various constituting elements, importing only those involving very specific requirements as to materials, gigantic dimensions, or special difficulties in assembly. The larger countries of the region, however, have attained the necessary capability to face this disaggregation process successfully and thus increase the percentage of local manufacture component. In Argentina, for instance, 50% of blast furnace No. 2 and all the oxygen steelmaking plant erected by SOMISA were built locally. Mexico is in a position to achieve 55% of local manufacture in ore-mining and pelletizing equipment, 40% in direct-reduction plants, 20% in rolling mills. In Chile, the local component of CAP's blast furnace No. 2 was over 55%. Market conditions and industrial capacity in Brazil reveal even higher percentages.

3.7 Specialized items. This class covers mechanical control equipment, bearings, seals, and other protected items, specialized systems normally made entirely by the same manufacturer (oil injection, oxygen enrichment), giant switches, engines involving sophisticated power and speed features, and other similar items. The way that many of these items are assembled does not allow their dis-aggregation, particularly in view of the limitations existing in Latin America as regards modern methodology and lack of the necessary equipment. It should be noticed that, as regards the apparent limitations stemming from

the large size of certain items such as converters, rolling-mill stands, etc. requiring large-capacity foundry furnaces and machining shops, experience is showing that modular design and assembly techniques allow such units to be made in Latin America at shipyards or workshops of even smaller capacity. In such cases, naturally, designs must be re-examined to adjust to environmental conditions. Hewitt et al (1) mention that the roller table for a certain rolling mill used to be made wholly in a heavy machine shop operating a broad range of facilities, and the table was fully assembled before shipping, which turned out to be both slow and expensive. By redesigning the modular principle was introduced, the frames and lower structures being now made at shops operating elementary machining facilities, and the sets of rollers being ordered from manufacturers operating "little more than a few lathes". Successful assembly of the finished unit on site is ensured by using simple patterns at the supplier plant during production. There are a great number of such units in a billet and section mill, in which case they are more easily made, and accordingly less expensive.

#### 4. CONDITIONS NECESSARY TO DEVELOP PRODUCTION

4.1 Having established the possibility of making quite a broad range of the equipment used by iron-ore mining and steelmaking plants, reference should be made to the conditions required for this process to develop harmoniously in the countries of the region.

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(1) E.C. Hewitt. "The Resources Necessary to Build Steelworks". Paper presented to the 12th Latin American Iron and Steel Congress, Rio de Janeiro, October 1972.

4.2 Market. As stated earlier, there is an interesting market in the region; mention was also made of the lack of information on the investments to be made in the medium and long term. Despite this major limitations and solely for the purpose of setting out the minimum investments required to fulfill development plans, an estimate will be attempted based on the available criteria. The difference between production expected by 1980 and that estimated for 1975 allows us to forecast an increase of about 21 million tons in the seven remaining years of the present decade. Brazil will be responsible for approximately 50% of this increase, the necessary investments being estimated at 3,000 million US dollars; this means that the total investment in the region will amount to about 6,000 million US dollars. It may be taken that there is no possibility of obtaining financing at such a level in the international market. The figures also help to visualize the magnitude of the demand for equipments in the region; consequently, it is to this market that manufacturers should address their efforts once they have become habitual suppliers of local industry.

4.3 Financing. This point has been mentioned as probably the most critical in starting construction of these goods on a suitable scale, because producers in industrial countries are supported by their financing agencies to promote making and marketing their production. In addition to being the most critical, this aspect is also the most difficult to resolve in view of the well-known weakness of the internal sources of financing in almost all our countries. The scope of this paper does not allow outlining financial schemes intended to overcome this obstacle.

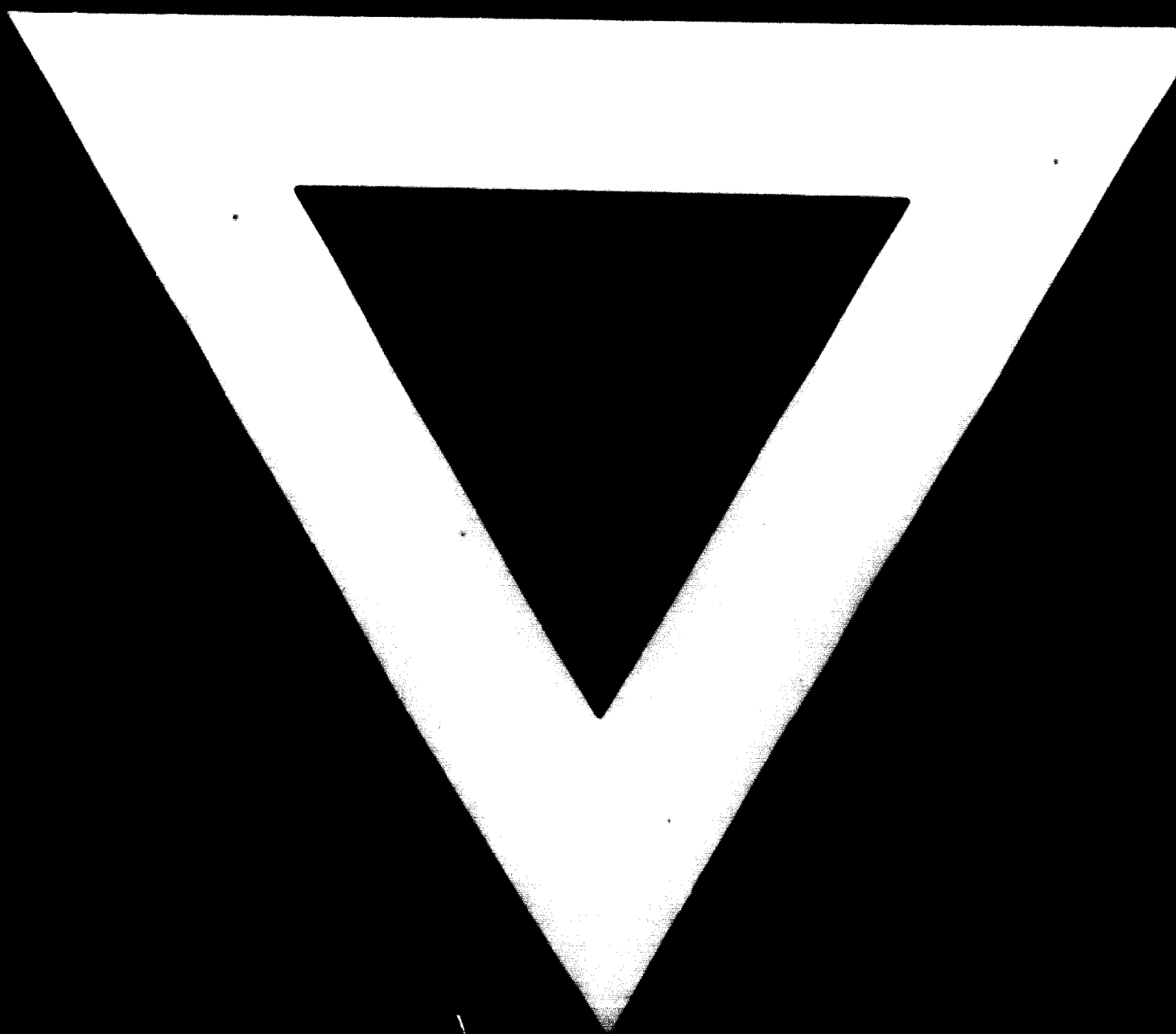


It is necessary, however, to point out the conditions that are deemed important for such schemes to accomplish the desired objectives. Firstly, financing must cover a major portion of the marketing, so that the producers may transfer the terms to their customers, thus counter-balancing those offered by foreign suppliers. Secondly, it is essential that part of the production costs be financed, for it is usually a matter of very high-cost items requiring significant amounts of materials. Thirdly, credit terms in regard to cost and prices should be the same as those prevailing in industrial countries. In most if not all our countries the agencies for financing industrial development will have to collect resources with a view to opening credit lines to local producers. For this reason, it should be stressed that the same government agency will have to absorb any exchange-rate variations taking place locally or in the country which made the credit lines available, in order to ward off disturbances that might seriously affect the long-term efforts that producers will be required to display.

4.4 Protection. As a rule industrial production in our countries was born and developed under protection from foreign competition by means of tariff barriers. Ore-mining and steelmaking activities being considered basic in these countries, erection and expansion of facilities are encouraged by exemption from import taxes, so that local manufacturers, unlike other producers, are not protected by tariffs. For this reason the terms of bids normally called for purchasing these items should include protection to local makers, in the form of a certain price margin to offset their higher costs derived

from the circumstances in which they operate. In Brazil, the most advanced country in this field, it is estimated that local equipment cost averages 50% more than imported items. In that country the local capital goods industry enjoys 15% protection in the international bids for purchasing equipment to fulfill the Brazilian expansion programme. Protection can also be granted by requiring a certain percentage of local components in plant equipment, a condition that can be included in international bids too, together with the price differential mentioned above. In this case the establishment of a control group such as the one suggested under 3.4 would be particularly significant.

4.5 Engineering and production technologies. The weak points observed in Latin America in these fields have been pointed out, particularly as regards project engineering. If the conditions discussed in this paper are met, correction of this deficiency will be largely facilitated. The internationally known manufacturers themselves will surely be the ones to seek the cooperation of local engineering, additionally encouraged to do so by protection measures favouring local services, which are in force already in most of our countries. Besides, the papers presented to the 12th Latin American Iron and Steel Congress (Rio de Janeiro, October 1972) showed the good will prevailing in the more advanced countries towards cooperating in the development of local engineering capacity. Regarding production technology for making specific units or components, international experience points to the advisability of starting such activities by purchasing licences and adhering to the traditional patterns of evolution of such technologies: purchase the knowledge, improve it, then sell it. That will surely be the road that this region will also follow.



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