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INFLUENCE OF LOCAL CONDITIONS IN PROJECT EVALUATION AND RELATED CASE STUDIES

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OUTLINE

Part I: ESSENTIAL ELEMENTS

I. Introduction

Developing Countries, both by nature and necessity should undertake exceptionally strong measures in selecting industrial projects for implementation in their development programmes. This is not only necessary to achieve the highest rates of development but it is imperative tho ensure the success of the project to be selected under the particular conditions of the developing countries.

A regular feasibility study aims at investigating the possibilities of realizing a certain project taking into account all relevant factors and analyzing the technical and economical aspects of such projects in as much detail as is necessary to justify the recommendations arrived at by such study.

Such a regular feasibility study, complete as it may seem, may lead to unpredicted failures when applied to development projects in developing countries due to prevailing local conditions in such countries which render such a study an unrealisable thesis, although the same factors considered in the study when applied in a more developed country could probably lead to a successful and profitable establishment.

In this paper, it is not our aim to give the elements of a proper feasibility study, as this is a standard procedure well known and practised by all those involved in development activities throughout the world. It is, however, our intention to throw some light on the influence of local conditions in developing countries on the feasibility studies prepared for projects proposed for implementation in such countries. Such influence may well prove to be decisive in the final decision concerning the execution of the project.

The importance of feasibility studies cannot be overstated. These are imperative to ensure a proper use of the limited resources of developing countries, and must be supplemented by a sound appraisal of local conditions that might spare the countries concerned some regrets as well as losses, which are costly in terms of both time and money. In other words, feasibility studies must be made but they should be undertaken with special forms on the prevailing peculiar conditions of the specified projects under consideration in the particular country interested in their implementation.

The UAR which started serious industrial development almost ten year ago has gained some experience in this field. If this paper can even partically convey this experience to other developing countries, it will have served its purpose, and the country will have paid part of the debt it owes to those more developed countries which assisted the UAR in the difficult years of initial development.

Our approach in this paper will be to classify the probable decisive local factors under various headings and to illustrate those factors through meaningfull case studies which should be useful for their probable applicability to other developing countries.

II. Market Survey

This survey is intended to estimate the probable size of the local market at the time of putting a certain industrial project into operation, as well as the export possibilities.

The importance of this survey cannot be adequately emphasized; the difficulty of arriving at an exact or even an approximate estimate is apparent, the estimate being a result of many complex factors.

The adequacy of statistical data is the first obstacle to confront a study group. An attempt to base estimates on records of past imports often leads to confusing information for several reasons such as incomplete specifications in records of imports (assuming that such records exist and are clearly classified), restrictions on imports resulting in unpredictable differences between imports and real demand, rates of custom duties which may encourage or discourage import and hence sales of one item or another. Powerful agents for certain products may raise imports of an item which might not be exactly what consumers would prefer if they had a wider choice. Per capita income, besides limiting the size of imports, may divert the demand to cheaper products even if these may prove inadequate for consumer needs, or even higher in maintenance and running cost.

These are but some factors that restrict the capacity to estimate local demand. Other factors such as expected population growth, rate of increase in the national income and per capita income, would equally restrict assumption of increase in demand prior to and after production starts. Factors, affecting the estimate for possible exports and probable export markets are even more complex.

Among these one can quote the cost of the product compared with world market prices, restrictive measures impos d by countries with potential markets, conflicting development projects in those countries, world progress in techniques and uses which may render the products obsolete at an unpredicted early date. Political factors, old established historical relations and traditions, must also be considered.

The interaction of all these factors often results in a very conservative estimate of the market potentialities and it can well be a reason to dissuade the authorities from such an adventurous attempt, or if such a project is ultimately executed, it is established with a small productive capacity, hence causing higher production cost, less mechanization, batch rather than line or mass productio , etc.

Extension of production i such cases comes almost immediately after execution and occassionally even before the initial production starts. This introduces several complications and always proves very expensive both in capital and running expenditure compared with an original one-stage construction with a combined capacity.

The estimate for the productive capacity of a proposed industrial project in a developing country is therefore a very difficult decision that needs, besides a serious market survey by experienced specialists, a sound logical assessment of the effects of local and foreign factors that influence that estimate. The final decision for the productive capacity is usually quite different from the original estimate arrived at through the conventional market survey.

The decision should come from within the country interested, after considering the advice of experts in the field of marketing, and should often be a policy decision. It should also be mentioned that a conservative estimate is rather unwise in case of developing countries, a recommendation which is probably not true for the more advance countries.

It is always wise to select specific industries for which a certain country is well placed and to make serious attempts to specialize in such industries to gain international reputation. These industries offer the best possibilities for unlimited expansion of production and exports, hence contributing tremendously to the country's efforts in development and helping to meet the increasing high demands on foreign currency for investment goods, industrial raw materials and other imports. Past traditions, availability of raw materials, abundance of specialized labour are among the most predominant factors in the selection of such industries for any developing country.

III. Raw Materials

Perhaps the availability and accessibility of raw materials necessary for realizing a certain project with the capacity required are the first to be ascertained both in importance and priority in any developing country.

Although this factor is not as decisive as the previous factor, in as far as the unavailability of raw materials does not necessarily mean cancellation of the project, it would be most unwise to give projects which depend on import of raw materials high priorities, as their execution would impose a burden on the country's development by their regular demand of foreign currency for raw material imports at a time when the developing country is in need of all its possibilities to invest in capital goods for its growing development in all fields. This is not, however, the case in more developed countries where the profitability of the project justifies its execution even when some raw materials have to be imported yearly.

There are many cases when a local raw material in a developing country may be used to replace a more or less conventional raw material as used in other countries. Here, we can cite the case of production of pulp and paper in the UAR. Lacking sources of hard or soft wood, the industry had to look for other raw materials, and agricultural residues, such as rice straw, and sugar - cane bagasse which proved to be a sufficiently rich resource. The UAR is now producing pulp from rice straw and bagasse in growing quantities to satisfy the country's growing needs. The necessity to import a small percentage of long fibre pulp at present, does not radically change the above theory. Soon, the UAR will be a pioneer the world over, in producing newsprint, also from sugar-cane bagasse.

The availability of raw materials is not in itself sufficient. Such raw materials should be accessible; An interesting example in the UAR being the cotton stalks. Cotton stalks being a good raw material for pulp production, was considered. Its abundance did not, however, justify its use. The cost of its collection (being scattered all over the country) as well as its use for industry is not at present justifiable. With increased development of the country, and rise in the standard of living, and the spreading of the use of liquid or gas fuels, cotton stalks may become eventually an available and accessible raw material for pulp production in the UAR.

IV. Choice of Process

In almost all industries, production of any manufactured item can be achieved by more than one process, the process to be adopted is selected by appraisal of the various industrially proved processes or by the system of elimination. Often, the process that proves most satisfactory in a developed country may not be the right solution for a developing country. Reasons for such difference of selection may be the use of a different raw material necessitating a special treatment, availability or scarcity of electric power thus giving preference to an otherwise electric process compared with an alternative chemical process. The degree of technical skill may often prove a decisive factor in the selection of a process unemployment in a country may give preference to a less mechanized or automatic process. Lime brick production in the UAR is an example where semi-automatic or even manual processes were preferred for plants to be established in rural areas, while full automatic plants were selected for urban areas, where higher skills prevail. Old established techniques may often persuade the authorities to continue production using the same techniques and using the existing skills, although a more developed technique would otherwise have been selected. Such a decision, though conservative as it seems, has other advantages in the unification of equipment, simplification of operation, maintenance, repair and training procedures, reducing stocks of spare parts and stand-by units, etc. Some other examples of the influence of local conditions on the selection of the manufacturing process, are the choice of oxidation under atmospheric pressure in the production of nitric acid, this process being lower in platinum consumption. Using gypsum for the production of sulphuric acid instead of the more conventional raw materials (sulphur or pyrite) has the advantage to limit imports of raw materials, though at the risk of a higher initial plant expenditure.

The above reasoning should not be taken as a basis by developing countries to content themselves with less advanced techniques. Developing countries should avail themselves with the latest developments and innovations in industrial techniques to have some competitive production, but this should be done logically and intelligently with the existing local conditions in the forefront of consideration.

V. Choice of Site

The normal factors affecting the selection of the most suitable site for a certain industry such as the location of the necessary raw materials, the markets for the production, the availability of electric energy and other facilities, etc., are more important in a developing country, since they have greater impact on final profitability of the project. However, there are other powerful factors that may intervene in case of developing countries. Such factors are often social or strategic and may force some sacrifice in the economy of some industrial projects.

One of the major problems confronting developing countries in selecting sites for industrial development, is the inclination to concentrate many of the major industries in or around the capital or large cities where the majority of the consuming power, the skilled labour, the more readily found supporting facilities and the better working conditions exist. This inclination may be rejected in favour of a more even distribution of industry. Regional planning is thus a necessity and often pushes the economic factors to second place of importance; otherwise, development problems soon become insoluble in regions of large population concentration, with a wide disparity of income levels between urban and rural areas.

Developing countries are thus often confronted with the difficult task of having to choose between concentration of industries in already built up and developed communities or bear the penalty of developing new communities, investing in the expensive service projects, when they need every penny they can spare for their productive development.

One of the decisive factors in the selection of site in developing countries is the problem of transportation; such a factor being less important in the case of more developed countries where a more complete network of various means of transportation (rail, road and water) generally exists and renders the choice less difficult.

VI. <u>Availability of Labour</u>

The rate of training the formation of the various categories skill and professions generally lags behind the rate of industrial development in developing countries and soon such countries find that labour availability is becoming more of a problem while unemployment of unskilled labour remains high. This curtails development and contributes to inflationary trends in the wage structure due to the natural law of demand and supply, and thus adversely affects the cost of production. Any efforts made in developing countries to speed up training and formation of labour may prove inadequate but any expenses made for such aims will always prove justified.

VII. Economic Analysis Factors

The conventional economic study is very useful in itself, but for a developing country, it should only be considered a point of departure, due to the limitations in the benefits to be obtained from it, as well as the dearth of some essential data that ought to be known to a developing country in order to arrive at a definite decision concerning the execution of the project under study or otherwise.

The standard method of capital/output ratio or profitability estimates are not enough in themselves; other factors important for a developing country include:

1. Knowledge of the life-history of the project.
2. The national gross rate of return.
3. The surplus rate of return.
4. The government revenue from the project.
5. The net foreign currency expenditure.
6. The anticipated foreign currency gain through export.

Other methods that are better applicable to cases of developing countries are now being devised, the cash flow discounting method being the one most used. It tabulates the project input and output throughout the projects lifetime in several tables of local investment, foreign investment and profit and loss statement; the rate of return for the enterprise, for the capital owner, for the national gross rate of return, the surplus rate of return, the government revenue, the foreign exchange, etc....

Other considerations that may govern the decision to be taken for projects in developing countries include:

1. Priority given to projects whose production is needed for other existing industries. This refers mainly to basic industries which do not generally look attractive from the feasibility study alone, but have to be undertaken for visible reason specially in a country aiming at an ambitious stable programme of development, or adopting a high level of planning. The iron and steel production in the UAR is an example of such industries.

2. Support of local market prices may occasionally be used to render a project economically sound. This is not normally recommended, but may occasionally be resorted to so as to protect an important project in its early productive life.

3. Scarcity of foreign currency may force a developing country to give special priorities to certain projects which have a high rate of foreign currency savings or a high yield of foreign currency income through exports, when regular feasibility studies do not justify such priority.

4. Projects aimed at raising the standard of living of the population generally have a special appeal in developing countries. This trend should, however, be closely watched as such projects are often less advantageous from the national economy point of view.

5. For countries seeking re-investment of the returns from earlier development and national savings, emphasis on those projects giving the highest surplus rate of return is generally advised.

VIII. <u>Comparing Alternatives</u>

Upon preparation of the feasibility report justifying the execution of an industrial project, a developing country should make a separate study to compare the various alternatives of executing this project. This will inevitably result in the selection of the most economic procedure of execution for the estimated production and returns, the time of execution being a factor in the comparison. Several internationally known methods for making this comparison exist; the most suitable method to the country in question has to be selected.

While the subject of integrated projects does not fall under the heading of comparison between alternatives, it often offers clearly beneficial alternative means of executing a project. It helps cut capital investment, reduces transport and other service costs and improves the economy of each unit of the integrated plant. Examples of adding a pulp mill from bagasse to new sugar mills, and a cement plant to a sulphuric acid plant from gypsum clarify this idea; both examples come from the UAR.

IX. <u>Sensitivity Factors</u>

Since it was made clear in this paper that developing countries will have to depend on estimates much more than the more developed countries, it would be wise to estimate the effect of discrepencies of some of the most decisive elements in an appraisal study report on the economy of the project and hence on its feasibility. These estimates, although involving a big effort, are well justified as a sign of warning, pointing to those factors seriously affecting the feasibility, where strict estimates have to be made and where a conservative attitude would be most wise. They would also provide a guide-line as to where certain deviations could be tolerated and to what extent.

Not all factors affecting the feasibility of an industrial project in a developing country are tangible. Lack of past experience and incomplete statistical information increases the number of these factors in less developed countries and hence increases their importance. Such factors may also be of a social, political and humanitarian nature, i.e. objectives of a developing country in regard to literacy, health, decentralisation of industry, national defence, etc.

Part II: CASE STUDIES

A. Project for Aluminium Production

I. Introduction

Aluminium industry, being one of the basic metallurgical industries, has been developing very rapidly compared to the iron and steel industry, due to the wide-spreading rate of using this new light metal in several engineering and domestic fields, viz, aircraft, vehicles, cables pipes and sections, foil, household utensils - etc.

In 1854, Cainte-Claire de Ville was the first to produce aluminium in a somewhat regular way by chemical methods. One kilogram of the metal cost about $300 compared to a gold price of about $350 at that time. In 1855 aluminium price came rapidly down to 60 $/Kg and in 1880 it was only 20 $/Kg. In 1886, the two scientists Heroult in France and Hall in the USA discovered independently, the conventional process of aluminium production by electrolysis from pure alumina (Al_2O_3) using an electrolyte of molten cryolite (sodium-aluminium fluoride). Soon after this the price sank quite rapidly till it reached 200 $/ton in 1939. Since that time aluminium price variation was almost controlled by few strong world producers who owned great beauxite resources and huge hydro-electric power generating plants, which enabled them to control the world export market of aluminium.

The conventional process of aluminium production is divided into two stages. The first is the production of high grade alumina from rich beauxite ores containing small amounts of silica by the basic "Bayer Process". The second stage is the reduction of alumina by electrolysis to the molten metal. The major characteristic of the electrolysis stage is the tremendous amount of electrical energy consumed in the process (17000-20000KWH/ton). Cheap hydro-electric or natural gas energy of not more than 5 mills $, greatly controls the process economy. The cheap energy which will be available from the . Aswan High Dam by the end of 1968 (about 10,000 million KWH/year at a cost of about 1,2 millimes or 2.8 mills $), gave the first initiative for the selection of the electrolysis stage in aluminium production with a 40 000 t/year capacity, in the present five year industrial development plan in the U.A.R.

II. Basic requirements of aluminium production

1) Electrical energy which will be assured from the High Dam power station at Aswan.
2) The need for raw materials of international grade and purity (high grade beauxite is not available in the U.A.R.). Replacement materials containing alumina, such as clays, caolines and nepheline cyanite are locally available in moderate quantities & qualities but require an extensive survey and pilot tests to establish the economy for alumina production. (The project therefore was based on the electrolysis of imported alumina as a start)
3) The need for auxiliary materials (carbon paste for anodes and cathodes are not available in the local market with the required quality. Also flouride salts such as cryolite and aluminium flouride have to be imported).
4) The need of an efficient and reliable means of transportation for the imported raw materials (about 3 tons for 1 ton of Al produced), especially if the plant is located near the source of cheap hydro-electric power generation in Aswan (1000 kms from Mediterranean ports)
5) The plant needs a high capital investment. A plant of 40 000 t/y. capacity needs about 750 working personnel for a semi-mechanized plant with a total pay of 400,000 L.E./year, compared to about 450 persons for a fully mechanized plant. The output value runs around 10,000,000 L.E./year, and the project cost about 20,000,000 L.E. The output/capital ratio is therefore 1:2, and the wages and salaries/capital ratio is 1 : 50 for a semi-mechanized plant and about 1 :75 for a fully mechanized plant. (Degree of labour skill being higher for the latter plant).
6) Ensuring a reliable source of high grade alumina and auxiliary materials on a long-term basis. It requires also a wide experience

and know-how and a long-term technical assistance to ensure the production of the required quality and quantity at an international cost level to withstand world competition, especially since this market is traditionally controlled by powerful aluminium producers with advanced production technology.

III. Local conditions and their degree of fulfillment of the above mentioned requirements

1) Electrical energy: About 4,000 million KWH/year (40% of the High Dam energy) is reserved for consumption in electrochemical and electro-metallurgical industries at its source in Aswan.

2) Raw Materials: Possible replacement materials for alumina production, other than high-grade beauxites, could be divided into three groups:

a) Beauxites with high Al_2O_3 content (45-55%) connected with somewhat high SiO_2 content (6-12%)

b) Clays and caolines containing moderate Al_2O_3 content (35-42%) but also a high SiO_2 content (30-45%).

c) Feldspar materials in the form of pegmatite or apatite rock and containing nepheline cyanite. The latter contains about 19-29% Al_2O_3, 42-62% SiO_2, 12-17% Na_2O and K_2O.

The first group could be processed by the usual Bayer process after fluxing the silica with lime in rotary kilns giving cement clinker; the alumina dissolving in caustic soda solution by digesting, then precipitated and calcined.

The second group could be processed for alumina production by the acid process using cheaper sulphurous or sulphuric acid to get rid of the silica; the alumina goes into solution, then precipitated and purified in the usual way.

The third group could be used by concentrating the nepheline cyanite, then fluxing the SiO_2 with lime in a rotary kiln, then dissolving in caustic soda to separate the cement clinker; the alumina is then precipitated and calcined in the usual way.

The U.A.R. possesses reserves of the second group in moderate quantities (15-18 million tons in Aswan and Sinai). Reserves of the third group appear to be present in great quantities in the eastern desert near Aswan. Present estimates give possible reserves at about 350 million tons between Aswan and the Red Sea.

Though the clay and caoline group of ores did not prove economical yet for alumina extraction, the USSR succeeded in the last years to use the nepheline cyanite group economically on an industrial scale to produce about 60,000 t/y. of Al_2O_3. and experiments to be done on existing raw materials will provide the U.A.R. with its own raw material resources to complete the stages of aluminium production. It is doubtless that cheap electrical energy from the High Dam could be considered in some way, a raw material for aluminium production which could be exported in the form of aluminium metal.

3) Choice of capacity and process: Feasibility studies revealed that the minimum economic capacity in the U.A.R. for aluminium production is about 20,000t/y. The local consumption of aluminium was estimated to increase from about 5000 t/y. at 1964 to about 22,000 t/y at 1970 due to the increased demand on electrical Al-cables for H.T. transmission lines and also on sheets, plates, pipes and foil for other domestic and irrigation purposes. It was also found feasible to change the insulated cable industry from copper to aluminium. The estimates showed that the demand on such cables will be about 20,000 t/y copper cables, equivalent to 8000-10,000 t/y aluminium cables in 1970; giving a total demand on aluminium metal of about 32,000 t/y in 1970. It was therefore decided to start the project with a 40,000 t/y capacity, so that by the date of start-up at the end of 1968, the net surplus of about 10,000 t/y could be exported; the foreign currency being used for importation of

alumina. It is assumed to expand the plant later to 80,000 t/y providing a better economy for the project.

The process retained viz. the horizontal stud Soderberg system with 75,000 ampere cells instead of the latest developed vertical stud Soderberg system with 100,000 ampere cells, was chosen for several reasons. The horizontal system needs less degree of skill, less accuracy in preparing the Soderberg paste, less capital investment in the capacity range under consideration, less mechanization and hence more employment. The combination of all these factors proved favourable.

4) Selection of Site: A comparison was made for three probable locations, Alexandria, Aswan and Quosseir (on the Red Sea). The factors considered ranged from cost of electric energy at each site, ease of transport, availability of the required manpower, distance from probable deposits of future raw materials and social factors. The decision was in favour of Aswan.

5) Economy of the project: Profits as a commercial enterprise are marginal but this project contributes tremendously to savings in foreign expenditure, introduces new techniques in industry, provides the basis for sound industrial development and helps increase the national income. It also provides employment for 750 persons.

6) Conclusion: The effect of local conditions on the selection of the process, the site, the capacity and the raw-materials is clear in this study of the introduction of aluminium production in the U.A.R. The main deciding factor being the availability of cheap and abundant electric energy.

B. Expansion of the Suez Refinery

Due to the fact that indigenous crude oils in the United Arab Republic are heavy asphaltic (16-30° API), it was estimated that products derived from these crudes in 1964 would be sufficient for the country's requirements on the basis of a ton of crude to a ton of product. Ordinary processing of such crudes would produce surplus fuel, oil and low quality gasoline. A deficit however, will arise in the production of middle distillates, namely kerosene, gas oil and diesel fuel which have to be imported with foreign currency amounting to £10,000,000 per annum in 1964.

Our goal was two-fold:

A. Get the highest yields of middle distillates namely kerosene, gas oil and diesel fuel from the available feed-stocks and

B. install the combination of facilities that shows the most attractive economic picture.

1. Raw Materials

The feedstocks are 1,700,000 metric tons per year of skimmed Belayim crude, 486,000 tons per year of full range naphtha, and 105,600 metric tons per year of asphalt and wax distillate from lube oil plant.

2. Required Products

Middle distillates are the most important products. The order of priority in their manufacture is kerosene, gas oil and diesel fuel.

3. Process comparison and selecting the most attractive processes

Process comparison:

A - The following process for the conversion of heavy fuel oils to middle distillates were compared:

1. delayed coking.
2. fluid coking.
3. hydrocracking.

The following factors were taken in consideration in the comparison.

1. to maximize the yield of middle distillate of suitable quality.
2. to minimize the yield of gasoline and lighter products.
3. to produce by-products which can be easily consumed.
4. to use processes which had been proven commercially.
5. to use the most economically attractive process.

With the previous goals in mind a combination of delayed coking and hydrotreating for the middle distillates was chosen.

B.- Different reforming processes for the upgrading of local low quality gasoline were also compared on an economical basis.

From process comparison, the most attractive process scheme was found to be delayed coking, Sinclair Baker reforming, and Union Oil process for hydrotreating. The table I shows a comparison of refinery yields. The delayed coking case yields 1,042,000 metric tons per year of middle distillates. This is almost 58 weight percent of the heavy oil charged to the plant.

In contrast, the fluid-coker case yields 929,000 metric tons per year of middle distillates for a yield of about 52 weight percent.

Total investment for the delayed coker case is $28,000,000. Fluid coking is $36,500,000.

Table II shows a comparison of investment and returns. The delayed coker case shows a higher profit than either of the fluid coker cases - and a substantially lower investment. The delayed coker case pays off in three years against a payoff of 4.1 years for the fluid coker cases.

TABLE I

A Comparison of Refinery Yields

Raw materials	Delayed coking		Fluid coking	
Skimmed crude	1,700,000		1,700,000	
Full Range Naphtha	486,000		486,000	
Asphalt & Wax Distillate	105,600		105,600	
Products				
Kerosene	573,000		517,000	
Gas oil	275,000		253,000	
Diesel fuel	189,000		159,000	
100 F-1 Gasoline	290,000		304,600	
Propane L.P.G.	46,200		72,400	
Butane L.P.G.	42,300		82,400	
Fuel oil	156,400x	82,400xx	195,400x	185,900xx
Fuel gas	70,800	0xx	107,300x	0xx
Light Naphtha	120,000		120,000	
Naphtha to Thermal unit	86,000		86,000	
Benzene	3,000		3,000	
Dodecyl Benzene	6,000		6,000	
Sulphur	28,200		29,000	
Coke	382,000		259,000	

x Before refinery fuel is deducted

xx After refinery fuel is deducted

All coke and fuel oil produced by the refinery are to be burned at the new power plant.

TABLE II

A Comparison of Investment and Returns
millions of dollars

	Delayed coking	Fluid coking
Investment	28.0	36.5
Annual Product Value	57.9	57.0
Annual Costs		
Raw materials	36.6	36.6
Refinery operations	3.4	4.1
OVERHEADS	1.5	1.4
DEPRECIATION	2.7	3.6
TOTAL	44.2	45.7
Annual Return on Investment		
Return before income taxes	13.7	11.3
Income taxes	7.1	5.9
Profit after income taxes	6.6	5.4
Depreciation	2.7	3.6
Cash flow	9.3	9.0
Payout years	3.0	4.1

4. Conclusion

The project itself was justified due to the characteristics of the local crude oil and the increasing demand of the middle distillates, while there exists a surplus in fuel oil and gasoline.

Local conditions influenced the choice of the process adopted and the capacity of the plant to satisfy the country's need by 1970. The location of the plant was unquestionable, being close to the Suez refinery where raw materials are produced and near the power-station using the coke produced as by-product.

C. Project for Iron and Steel Production

I. Introduction

Iron ore was first discovered in Aswan. The ore in that region is the type Hematite with an Oolitic structure containing an average grade of 40% Fe and 12% silica. Sulphur is almost nil.

Spectrographic examination indicated the presence of titanium, molybdenum, vanadium and copper.

Prospection work on an industrial scale began in that deposit in 1954/55 after the many studies and research work carried out since 1932 for the possibility of starting heavy industry.

The reserves estimated from the various investigations are about 160 million tons. Although iron ore was detected in Baharia Oasis - (now under exploitation), and Kosseir, more attention was paid to Aswan deposits on account of its good quality, ease of extraction (being horizontal beds) - and accessibility to the Nile Valley and main transportation arteries.

II. Realisation of iron and steel industry

Despite the coal problem which is a vital one (coal being unavailable locally), the internal urge for industrialization made it quite imperative to establish an iron and steel industry.

1. Iron and steel plant (Helwan)

Installation of the first iron and steel mill in the UAR - the Helwan Plant - was decided upon the following local factors prevailing in 1954.

a) Process

The process chosen for reduction of iron ore, utilising blast furnaces, was due to non-availability of low cost electric power.

b) Location

Although the general practice in such industry is to install the plant within the vicinity of the mines, and although Helwan which was chosen as site is 1000 kms. from the deposits, the local conditions played a big role in such a choice.

These conditions could be summarised as follows:

1. Transport

Prevailing local conditions and costs of transport; operations in the country was a deciding factor in the selection of site.

The comparison table given below indicates the charges to be added to each ton of product in both cases (Aswan and Helwan).

The result is that a saving of 30% of these charges is realised in the case of Helwan.

Material	Charges/ton of products in Aswan	Charges/ton of products in Helwan
Iron Ore	-----	L.E. 4,200
Coke (imported)	L.E. 3,600	" 1,200
Dolomite & other raw materials	" 1,000	" .500
Pig Iron (produced)	" 3,000	-----
	L.E. 7,600	L.E. 5,900

2. Characteristics of materials to be transported

Transport of coke; required for reduction purposes from the UAR ports on the Mediterranean, ensures its arrival in a good structural condition which could not be fully attained in the event it is transported to Aswan - 1,100 kms, far from any other port.

Transportation of some finished products such as sheets and sections, to various industrial enterprises in the country, is more economical and easier in the case of Helwan, taking also into consideration that a single railway line exists in upper Egypt.

c) Man-power and wages

Man-power in 1954 was not available at Aswan in the amount and qualifications needed. Skilled labourers, technicians and qualified staff could only be found in central industrial areas such as Cairo and Alexandria. Furthermore, provision of living accommodations and facilities for a staff in Aswan as well as the cost of the various incentives to draw such a staff, would add heavy charges to the cost of production.

d) Capacity

The capacity of the Helwan plant was estimated at 300,000 T/year to meet with the requirements of the country at that time. Realization of the first and second industrial programme necessitated an extension. It has been planned in the second 'Five Year Plan' to increase the capacity of the plant to 1.5 million T/year; this will cover the country requirements expected in 1970.

2. Iron and steel plant (Aswan)

In 1965, it was decided to establish a new integral iron and steel plant at Aswan with a productive capacity of 300,000 T/year of reinforcing steel bars, to be increased in a second stage to 600,000 T/year.

The factors influencing such a decision were:

a) The increased local demand of R.C. bars both in the UAR and neighbouring countries.

b) The expected exploitation of the Baharia iron ore mines by 1968, to feed the Helwan iron and steel plant, thus rendering the Aswan iron ore mines superfluous by that time.

c) The availability of large amounts of low cost electric energy at Aswan as a result of the electrification at the High Dam by 1969.

d) The recent developments at the Aswan area in the social and technical fields which made it feasible to expect the necessary skills, amenities, housing to be available there by the time of operation of the proposed steel complex.

3. Extension of the Helwan steel plant

The development of heavy industries in the U.A.R necessitated a revision of the iron and steel production based on demand. A review of the cost of production of the existing plant, the potentialities of the newly discovered Baharia ores and the expected demand of the local market resulted in an ambitious programme of increasing the iron and steel production at Helwan from the present 300,000 T/year to about 1.5 million T/year, all from Baharia ores. The necessary extension covers all sections of the mill and includes a strip mill of ultimate capacity of 750,000 T/year. The iron and steel industry in the U.A.R is thus experiencing drastic changes which will turn the country into the biggest producer in this line in the whole of Africa.

III. Conclusion

The selection of site seems to be the most serious decision based on consideration of local conditions. The process was decided to suit the local ores used and the capacity decided upon. The unavailability of coal and abundance of cheap electric energy at Aswan was the main factor in deciding on the Aswan mill using electric smelting.

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