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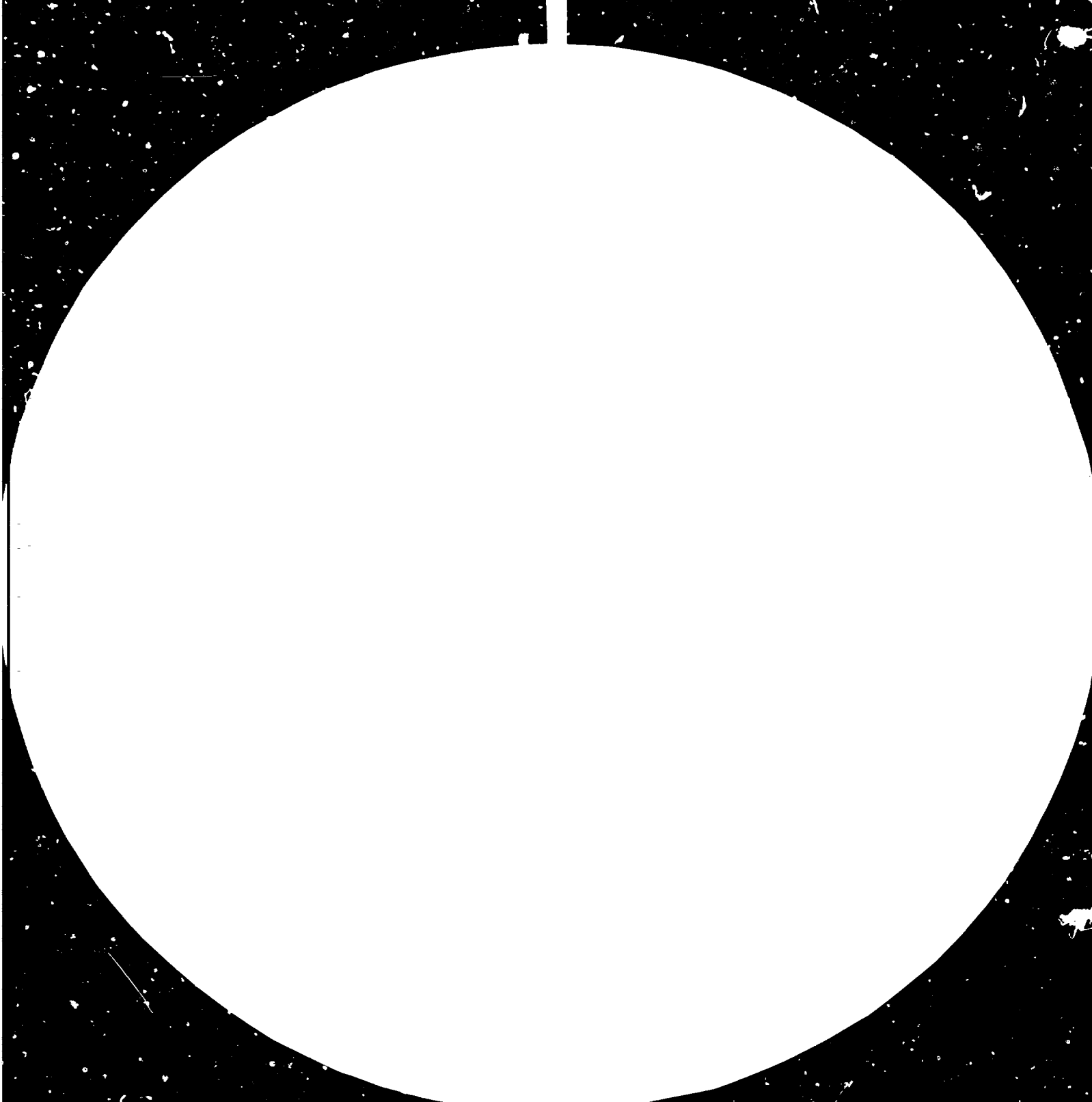

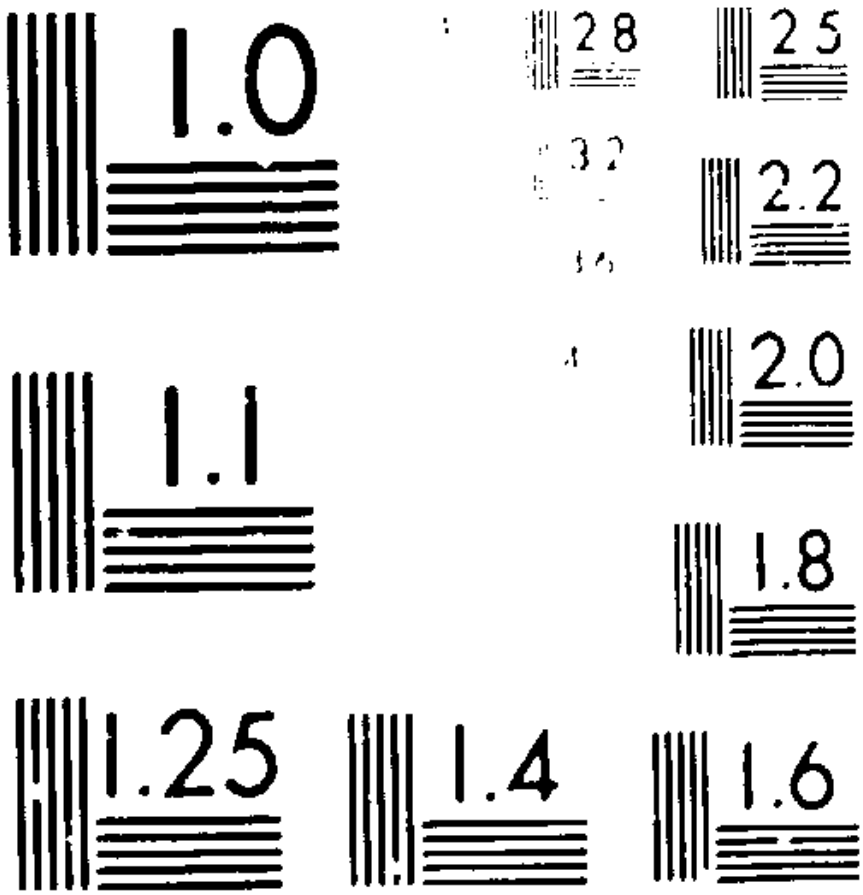
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Distr.
LIMITED

ID/WG.324/1
1 August 1980

ENGLISH
Original: French

United Nations Industrial Development Organization

Global Preparatory Meeting for the
First Consultation on the Capital Goods Industry

Warsaw, Poland, 24-28 November 1980

CONCEPTS AND PROPOSALS CONCERNING NEW CONTRACTUAL AGREEMENTS FOR SETTING UP A CAPITAL GOODS INDUSTRY *

by

A. Benbouali**

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** UNIDO Consultant

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The search for new forms of industrial agreements forms part of an approach towards rebalancing industrial relationships between the industrialized countries and the developing countries. It is intended to supplement the present approaches which tend either to implement a new world economic order or to effect modifications in the existing forms of industrial agreements.

At the industrial and sectoral level these approaches will unfortunately be unable, in the immediate future, to provide a satisfactory answer. Conscious of this gap, the United Nations Organization for Industrial Development (UNIDO) has accepted the responsibility for putting forward the concept of a sectoral development contract at a bilateral level. This initiative, combining the advantages of the previous approaches and supplementing them, attempts to establish balanced relationships between partners at different industrial levels, in a precise industrial sector and in the long term.

In order to retain its universal character it is important that this contribution should not be limited to formulating a new tool for contractual relationships but should ensure that it is possible to adapt it to the diversity of situations in the partners concerned from the North and from the South. Taking account of this desire for equilibrium, the concept of a bilateral agreement and the necessity for long-term relationships, this proposal should consist of a demonstration of a method for constructing new forms of industrial agreements, suitable for each sector and each partner.

Can such an approach, attractive as it may appear to be, lead in practice to the drawing up of new forms of industrial agreements? This question may find an answer in attempts at application at sector level. The choice of the experimental sector has fallen on the iron and steel industry for the following reasons:

- the state of advancement of UNIDO work in this field;
- the ease of collecting the information required by the method;
- the special place of the iron and steel industry in the process of industrialization of the developing countries.

One may reasonably ask, therefore, why such a paper is being placed before a meeting dealing with equipment goods. It seemed to be important, in the present state of UNIDO work in this sector, to demonstrate the contribution of the concept of a sectoral development contract. The work in hand, covering typology, the level of complexity of the products, the multi-purpose nature of the production apparatus and possible routes of entry for the developing countries, cannot produce any definitive results for many months. However the possibility of using such a method could make it possible to assist the developing countries in the immediate future to promote the local production of equipment goods such as standard items of equipment. Furthermore, as can be seen from its application to the iron and steel sector, it is possible to establish the bases for increasing the national production of specific and standard equipment goods through sectoral contracts.

The essential value of such a paper lies therefore in the demonstration of a method for drawing up new industrial agreements even if, for practical reasons, the iron and steel sector has been selected as the field of application. The method does however remain a general one and, in particular, is applicable to the equipment goods sector.

Defining a sectoral development contract

Before presenting the method it is important, in the interests of better general understanding, to define the concept of a sectoral development contract. The definition which seems to us to be the most pertinent is as follows:

"A sectoral, multiform and long duration contract between two partners of different industrial level, based on a balanced exchange of the following type: a quantum of development against strategic resources. Arising systematically from the sectoral analysis of potentialities and complementarities it assumes the collaboration of all the partners concerned under the respective leadership of their governments. The overall

equilibrium of the contract therefore lies in the acceptance, by the parties concerned, of drawing up a long-term programmed list of development objectives, on which are to be structured the legal, technological, financial and commercial architecture of the contract. As a counterpart of this co-operation, and of the keenest prices, the less industrially favoured partner is assured of consequent compensation from the other partner."

A statement of the method

Starting from a specific industrial sector, the developing country needs to establish the progressive levels of industrial mastery and, where necessary, to draw up the tree of technological decisions, to clarify the system of the components involved in taking investment decisions, to understand those factors which fall outside his influence, to analyse the forms of control on these elements, to appreciate the links between these roles, to appreciate his own situation, to draw up the list of the factors in the negotiation, to analyse the long-term development of his resources, to consider possible solutions and to distinguish those solutions which arise from North-South negotiations, from South-South co-operation and arising from bilateral agreements, to locate possible supplementary partners, to appreciate their strategy in the sector, to establish a system of compensation and, finally, to construct the consequent industrial agreement.

Such a method therefore requires a good understanding of the sector, its technological development, the actors and their strategies, for its application. It implies, in the case of those countries of the South which use it, an understanding of their own level of industrial mastery, the defining of a development strategy at sector level, a ranking of the intended objectives and, finally, the desire to escape from the conventional technology/money exchange. Experimental application of the method would seem therefore to be essential for demonstrating its utilitarian character. The studies in the annex will make it possible to follow up the pathways in the process of analysis in the industrial sector. The first study is devoted exclusively to the application of the method, and results in the fundamental subjects to be written into a development contract. The second study deals, in a more detailed manner, with the analysis of the previous conclusions so as to test their coherence and to construct the system of support and counterpart. Whilst the first study attempts to justify the concept of a sectoral development contract and to locate its place in international economic relations, the second utilizes the information supplied in the first so as to attempt

to list the possible subjects for a development contract in the sector.

The results of the method

These will be set out in a summary manner, grouping the conclusions together.

Principles for constructing industrial agreements

- structuring the industrial agreement around complementary partners: engineering companies, iron and steel producer, equipment suppliers, Final Client, governments of the countries concerned;
- balancing of the contract, based on guarantees of long-term sectoral development as a counterpart of a guarantee of supplies of strategic resources;
- breakdown of the risks of the contract in accordance with the natural responsibilities of each partner;
- planning the development of objectives;
- prior choice of the counterparts, and establishment of a system of premiums linked to achievement of the objectives;
- limiting competition on the basis of an analysis of the potentialities and complementarities of the possible partners;
- construction of the organization diagram of relationships between the partners.

Possible subjects for the development contract

Financing

- linking financing to the results from increasing production;
- extension of financing to cover the financial needs resulting from the period of achieving full production;
- extension of the financing to cover needs for local currency.

Investment costs

- analysis of the technological choices offered, and the choice of economic variants;
- elaboration, by the competent partners, of the detailed contents of the design studies, complete and suited to local conditions.

These studies should be available prior to the negotiations so as to facilitate agreement between the partners, without ambiguity and without financial surprises;

- rejection of classical construction solutions which commit the partners in the industrialized countries neither technologically nor financially.

National integration

- establishment of national engineering capabilities at detail, general design or process engineering levels;
- search for an integration objective compatible with intersectoral planning, and the implementation of the corresponding resources;
- analysis of the problem of local manufacture of spares, and acceptance of the objectives fixed in the sectoral development contract;
- extensive usage of techniques of utilization of the iron and steel products from the future plant, and the assistance of partners in the due realization of this objective.

Reaching full production

- implementation of a technological transfer organization, responsible for supervising the realization inter alia of the following conditions:
  - . quality and volume of the relationships between the partners,
  - . adaptability of the concept to local conditions,
  - . teaching and dynamic organization of reaching full production,
  - . quality and volume of documentation and training (individual and collective);
- assistance in the local manufacture of spares, the establishment of useful stocks and the rapid delivery of imported parts.

Management

- establishing supplies of raw materials (coke), consumables and spares according to formulae guaranteeing the stability of prices and deliveries;
- assistance in improving productivity;
- implementation of social conditions guaranteeing personnel stability.

System of counterparts

Establishing a system of counterparts is complex, since it depends on the potentialities and complementarities of the partners and also on the number and volume of the objectives which have been fixed.

In order to select the system which is most suitable, the developing country must, first of all, establish basic formulae of the following types:

- financial premiums;
- long-term delivery at preferential rates of mineral or agricultural materials;
- long-term commercial agreements:
  - . on iron and steel products
  - . on equipment goods.

The country must choose between these various formulae after having tested their respective values from the point of view of each partner. In fact it is probable that the optimum solution will be a combination of these formulae, making it possible to define at all times that financial involvement which is most suited to the partners concerned by the success of the objectives of that period.

The system selected must be sufficiently interesting for the State of the industrialized country to agree to guarantee the development contract in such a way that this guarantee can operate naturally, throughout the progress of the contract, in favour of the realization of the objectives which have been fixed.

Conclusions

International economic relationships are characterized by increasingly marked inter-dependence with the development of exchanges. The developing countries have progressively realized the need to establish this inter-dependence on more just bases, conscious in this respect of their own economic backwardness but also the value of their resources. In order to arrive at this position various routes for negotiation have been opened up between the countries of the North and of the South. Our proposal is one of these possible routes; its principal merit is that it presents a formula which meets the needs and possibilities of the developing country.

Exchanges in monetary form are particularly suited to the industrialized countries, carrying out trading in goods and services, since their level of development allows them to utilize fully the advantages of such a practice. By contrast, in the case of the developing countries, monetary exchanges do not operate in their favour, even if they have major financial resources. In fact, in the field of technology it is not sufficient to have resources to buy well, use well and manage well. Any formula making it possible to achieve a kind of technological exchange against resources brings partners at different industrial levels to a better balance, since it places them in positions of equality in the event of non-conforming exchanges.

It is therefore one of the merits of the development contract that it takes into account the organization of the economic interdependence on bilateral bases, allowing balancing of the relationships between the partners by a system of counterparts, and, finally, of establishing co-operation on methodical bases.

PRESENTATION

Our previous study on industrial relationships between the developing countries and the industrialized countries has shown the necessity for establishing new forms of cooperation. Industrial agreements need to be established on the basis of a long-term development contract which takes into account the specific nature of the industrial sector, the technological level of the partners and the intended objectives.

The principles of equilibrium, cooperation and interdependence also assume the establishment of a system of reciprocal counterparts, ensuring balanced dependency. The formulation of this new type of industrial agreement is therefore the result of a methodical approach applied to the selected industrial sector, casting light on the actors and their various interests. The architectural construction, adapted to the diversity of situations and the requirement of long-term relationships, results in a development contract. In order to illustrate our approach the sector chosen is the iron and steel industry.

Utilizing the results of this study, and remaining within the iron and steel sector, we then propose to continue our approach by analysing, in greater depth, the influence of the principal factors in such a way as to optimize their integration, and in this way to structure the bases of cooperation. The essential objective is therefore one of exploiting the method[1] more completely by demonstrating its capacity to supply the true subjects of a development contract and also its capacity to integrate more ambitious objectives such as the national production of equipment goods.

In order to illustrate the selected plan of working the diagram on page 3 makes it possible to identify the various factors and their relationships. The object of our study, in the first part, will be to analyse these relationships and so to establish the principal conclusions for the iron and steel sector. The second part, devoted to new industrial agreements, will proceed to integrate the conclusions within the development contract, making the counterparts and supports coherent but without omitting to specify the prior conditions for such a negotiation.

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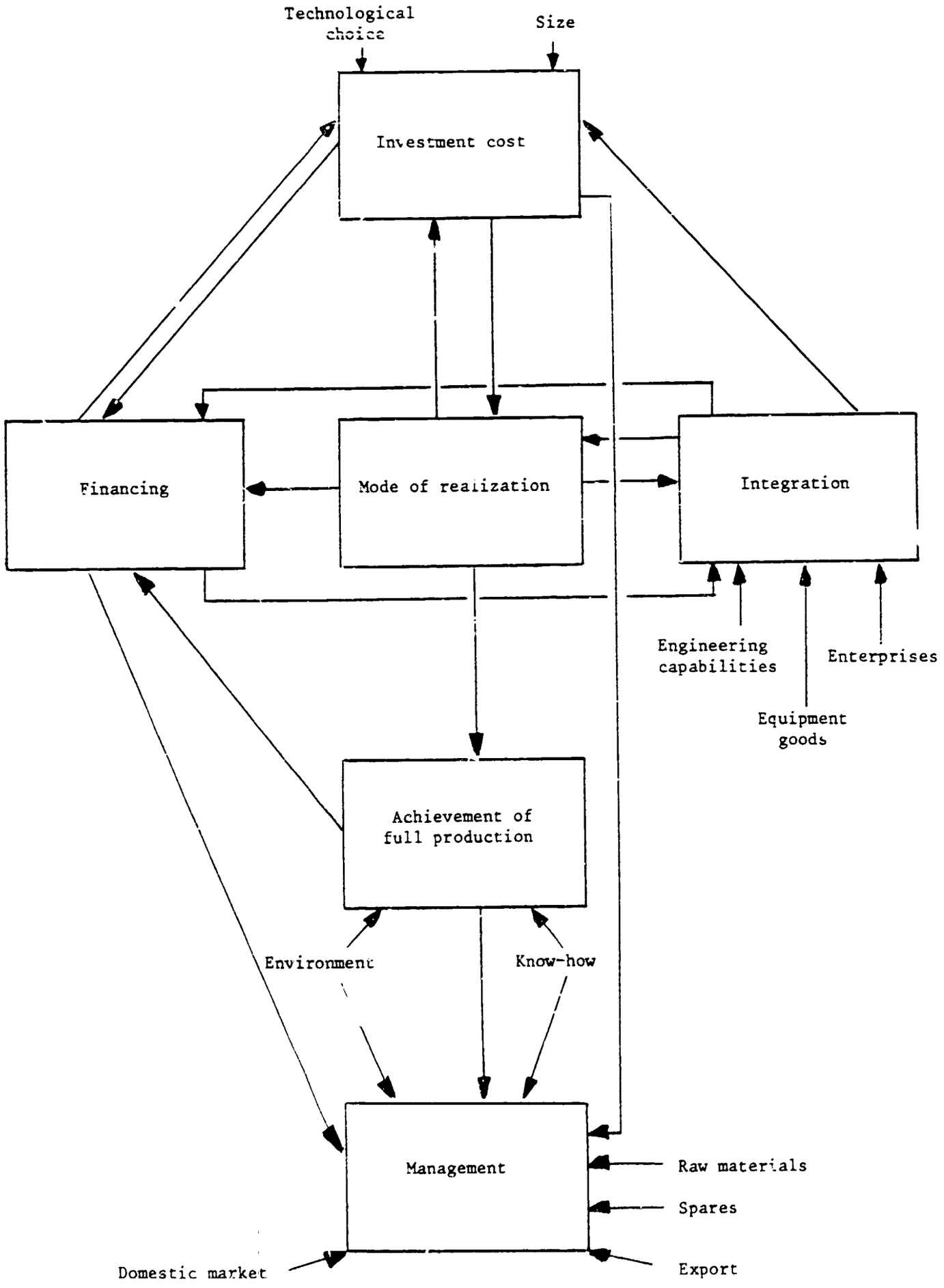
(1) See previous study, page 4, Methodological aspect.

Finally, and in order to ensure the realism of our approach, we will analyse the possible forms of conflict between the partners and the ways in which these can be resolved.


Technological choice
Size
Investment cost
Financing
Mode of realization
Integration
Engineering capabilities
Enterprises
Equipment goods
Achievement of full production
Environment
Know-how
Management
Raw materials
Spares
Domestic market
Export

I. ANALYSIS OF THE FACTORS

From the standpoint of the long-term relationships between an industrialized country and a developing country, particularly in the iron and steel field, it is important to determine the essential bases of these relationships. By utilizing the results of our previous study, and more particularly the system of the factors for decisions and the system of forms of control, it is possible for us to show these factors and their links on a diagram.

Successively, therefore, we will be studying the following factors: investment costs, financing, integration, achievement of full production, management.

I. INVESTMENT COST

Investment cost is an essential factor in the iron and steel industry because of the size of the financial sums involved in such an investment. Generally speaking the unit cost of investment per tonne of steel is a function:

- of capacity,
- of the technology chosen,
- of the mode of construction,
- of the mode of financing,
- of the level of integration,
- of the level of under-development.

This relationship, with its many variables, must be clarified for the iron and steel field.

I. Structure of investment cost

In order to identify the importance of the various factors in the continuation of our study we will indicate a basic structure of investment costs in the iron and steel industry. Our own information, confirmed by other sources(2), makes it possible to establish a structure valid for a non-turnkey construction. The figures which we supply are essentially orders of magnitude and refer to an iron and steel investment of the conventional type.

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(2) in particular IREP, November 1979
Capital goods for the iron and steel industry in the developing countries.

Comparison with the information obtained from other sources poses the problem of the coherence of the headings. For this reason we propose a relatively detailed structure of the investment costs, both to facilitate comparisons and also to allow us to establish a more detailed analysis.

The breakdown of the investment costs can be set out in the following form:

Equipment	production	30%	
	structural metalwork	6%	42%
	miscellaneous, cables and pipework	6%	
Erection	mechanical	1%	
	electrical	1%	6%
	carpentry	3%	
	painting	1%	
Civil engineering	construction	8%	
	earth works	6%	18%
	buildings	4%	
Engineering and supervision	civil engineering	5%	
	electrical	2%	10%
	pipework	1%	
	mechanical	1%	
Miscellaneous listed	spares	3%	
	training	1%	10%
	transport	2%	
	commissioning	4%	
Miscellaneous			4%
Taxes			10%
		TOTAL	100%

We find a rule which is valid for all the basic industries (iron and steel, petrochemicals, cellulose and paper, etc.): the contribution of equipment is of the same order of size as that for work and services on site.

I.1.2. The influence of the size of the investment

Information from the various sources in our possession, such as the various indications provided in the UNIDO document[3], makes it possible to establish the following relationship between Y, the unit cost per tonne of steel, and X, the capacity in millions of tonnes. On the basis of the UNIDO figures, and with a basic index cost of 100 per tonne of steel for a basic capacity of 5 million tonnes per year, using the conventional route for flat products and for a new plant, we obtain:

$$Y = 135.86 \times X^{-0.22}$$

or, again, we can formulate the following rule:

Investment cost is proportional to capacity to the power of 0.78. This law is confirmed, by our own sources, for capacities greater than 1 million tonnes and shows, in particular, the importance of scale effect up to capacities of 2 million tonnes. Beyond that the gain becomes marginal for a developing country confronted with other types of constraints. In the production of long products scale economies would seem to be less than in conventional production lines, and the maximum scale economies are obtained at 300,000 tonnes per year[4]. In the same way in the direct reduction route scale effects are considerably attenuated beyond a capacity of 600,000 tonnes per year. Finally the unit investment cost is lower for extending a plant than for the creation of a new plant.

I.1.3. The influence of the technological choice

Qualitatively speaking it is accepted that the choice of the conventional route is more costly than the choice of the direct reduction route. Furthermore within the conventional route itself the choice of

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(3) The World Iron and Steel Industry (Second study) UNIDO/ICIS 89, November 1978.
Manual for the Preparation of Industrial Feasibility Studies (UNIDO 1978).

(4) World Industry since 1960: Progress and prospects. UNIDO 1979.

the flat products sub-route involves higher costs. However the use of the continuous casting technology contributes towards reducing costs in all the routes as compared with the more traditional solutions. For this reason it is difficult to put forward orders of magnitude for comparison of the various routes, especially because of the influence of scale economies. Finally the increase in the long-term investment costs, higher than inflation, increasingly differentiates the costs in each route with time.

I.1.4. The influence of the mode of construction

Although it is difficult to identify the specific influence of this criterion (because few examples for comparison exist, in the same countries, between the various methods of construction in the same sector) we can however confirm that the investment cost increases, at the present time, with the degree of contractual aggregation. In particular it is accepted that the minimum excess cost of a turnkey formula, as compared with purchase in separate units, is 33%, part of which can be justified by the additional costs and services, the remainder by provision for risks and additional profits.

This multiplying coefficient also varies as a function of political criteria (risks, etc.), of economic criteria (local productivity of labour, existence of an infrastructure, level of technological mastery, etc.), and of cultural criteria (adaptation of expatriate personnel, proximity to the parent country, education, etc.). All these criteria, as evaluated by the industrialized partner, can vary the multiplying coefficient between 1.33 and 2 or even more in special cases. As an indication we have attempted to break down a multiplying coefficient of 1.33. It would appear that half the excess cost results from real and additional services provided by the constructor, the remainder being divided equally between excess profits and provision for risks.

I.1.5. Influence of financing

Without going into detail, since this factor will subsequently be analysed, we can emphasize the impact of the interest payable and the mode of credit, whether buyer or supplier, on the cost of the investment.

However the analysis is complicated by the influence of the mode of construction, of the amount to be financed, and its distribution between internal credits and external credits, and the time required for construction. It is accepted, as a general rule, that the interest payable during the construction period constitutes a cost which must be integrated into the total investment. In particular in supplier credits the cost is integrated directly into the supplies contract. The diversity of cases consequently results in a wide range of estimates of the cost of the interest payable; in general this item is evaluated at between 1 and 5% of the total investment. Overall formulae for construction and supply of credits are the most onerous in this respect.

I.1.6. Influence of the degree of integration

Those modes of construction which favour the national integration of equipment goods to the highest extent tend to induce higher investment costs because of a limitation of competition. This phenomenon is even more clearly shown in the developing countries at the beginning of industrialization since it is accompanied, in the absence of total mastery of the project, by delays in building which are extremely costly and which can represent up to 3% of the cost of the investment per month of delay. As far as the cost of this integration is concerned certain developing countries allow an additional 30 to 40% on the import price in favour of national production. It is consequently conceivable that investment cost would increase with the phenomenon of integration of local equipment goods, but could also sometimes be reduced as a result of the lower cost of local labour.

I.1.7. CONCLUSIONS

Investment costs in the iron and steel sector depend very largely on the mode of construction which is chosen and size, particularly in the production of flat products. It depends also on the national capacity to master the project, on local objective conditions, on a coefficient of risk as evaluated by the industrial partner, and the evolution of costs with time.

These initial conclusions allow us to identify those parameters which influence the cost factor, but we must also take into account the internal factors in the increase in cost. The tax and customs systems of the developing countries, the absence of infrastructures, the environment at industrial, social and communications levels, and the system of internal financing, create additional charges which are imputed to the investment. All these elements, added to the previous conclusions, can explain the existence of a ratio of 2.3 between the unit cost of investment in the developing countries and the unit cost in the industrialized countries.

I.2. FINANCING

The problem of financing is shown in its full seriousness for those developing countries wishing to build an iron and steel industry. A number of factors would seem to influence this, in particular:

- financing conditions,
- investment cost,
- the mode of construction,
- the degree of integration,
- the rate of achieving full production.

We will be examining successively the influence of these factors through the specific aspect of their influence in the iron and steel industry.

I.2.1. The influence of financing conditions

Financing in the field of the iron and steel industry is subject to the influence of the basic credit conditions: rates, duration and deferred reimbursement. However in this sector, because of the high cost of the investment, its low profitability and the time required to reach full production in the developing countries, these factors play an even larger rôle. The total sum required for financing is, for example, of primary importance in the decision to invest, as is also the duration of the credit which considerably affects the balance of payments of the investing country. One can easily understand, therefore, the reason for the delay in launching new projects in the countries of the South which do not have major financial resources and which cannot obtain interesting financing conditions.

I.2.2. The influence of investment costs

On the basis of the analysis which has already been carried out on investment costs, and more particularly on the relationship between cost and capacity, we can understand the financing difficulties for large capacity projects. If one looks at the influence of the technological factor it is easy to understand the difficulties in financing projects using the conventional route for producing flat products. By contrast in the case of the routes producing long products, or involving direct reduction, since the maximum scale effects are very limited the unit investment cost rapidly flattens out. Small sized units are more economic and require less capital and should consequently be more easily financable by the countries of the North.

I.2.3. Influence of the mode of construction

The mode of construction influences the investment cost, and therefore we should logically expect that financing would be more difficult for formulae of the turnkey type. In fact this is not so.

In effect the size of the contract, the political and economic links established by the constructors and the load of work involved, together with the financial gains which are expected and the simplicity of financing by a single contract, encourage the countries of the North to offer financing. In the same way the countries of the South tend to prefer such a method of construction because of the ease of obtaining financing. This is a point which merits more detailed analysis. If we let X the investment cost on an engineering consultancy basis for a given annual capacity of steel, and if Y is the corresponding turnkey cost, we have already noted that Y = 1.33 X. If we accept a breakdown of Y into 80% currency and 20% local money, and a breakdown of X into 70% currency and 30% local money, then, as a general rule, turnkey contracts benefit in regard to external financing at a rate of 80 to 90% of the currency part; we may assume a figure of 85% here. External financing of a turnkey contract therefore corresponds to 68% of Y, or 90% of X. In the formula with engineering consultancy the compression due to numerous contracts results in a rate of external financing which rises at the maximum to 65% of the currency part, and hence is 46% of X.

The gap between the two forms of financing corresponds, in fact, to the gap between the currency part increased by the excess cost factor. The arguments in favour of easier financing of overall formulae must therefore be used prudently by the countries of the South. By contrast it is undeniable that the latter formulae benefit from more interesting financing periods and from staggered reimbursement periods because of the link between reimbursement and provisional acceptance of the whole of the project rather than to the delivery of any particular part of it.

I.2.4. The influence of the degree of integration

Generally speaking a high degree of integration in the engineering consultancy formulae reduces the requirements for external financing, but conversely major external financing requirements penalize national integration, as in the case of certain Latin American countries.

In formulae of the turnkey type local integration is not greatly desired by the industrial partner, and the financial organization does not offer credit except on the basis of the total goods exported; from this it follows that in all cases a political desire for national integration cannot be accommodated to the conventional sources of financing.

I.2.5. The influence of the rate of reaching full production

The rate of achieving full production affects financing in several ways:

- by its influence on the capacity for reimbursement,
- by the need for supplementary financing resulting from possible losses.

In fact whilst the need for financing during the investment phase is clearly appreciated the subsequent needs during the first years of production are regarded more casually, since these are traditionally covered by internal financing. It is necessary to indicate these needs clearly so as to show:

a) the importance of the rate of achieving full production on cash flow problems,

b) the magnitude of the actual needs.

I.2.6. The problems of operational financing

In order to make it possible to understand these problems we have established a very simple mathematical model, the details of which are given in an annex, and which will make it possible to visualize, by way of the graph on the following page, the changes in the operational cash flow for an iron and steel unit in a developing country.

It seems to be possible to identify three distinct phases:

Phase 1: the loss-making results of production are added to the effects of credit reimbursements, and the maximum level of cash flow problems reach the level of the total investment costs.

Phase 2: production reaches its maximum level, the cash flow position is improved whilst the possibility of amortization creates monetary reserves for cash flow needs.

Phase 3: the period of amortization is completed and the influence of taxation is felt on the results; therefore the improvement in the cash flow position becomes slower.

We have, on the basis of this reference situation, considered several variants:

a) investment in the developing countries benefits from reduced costs, but with an unchanged rate of achieving full production;

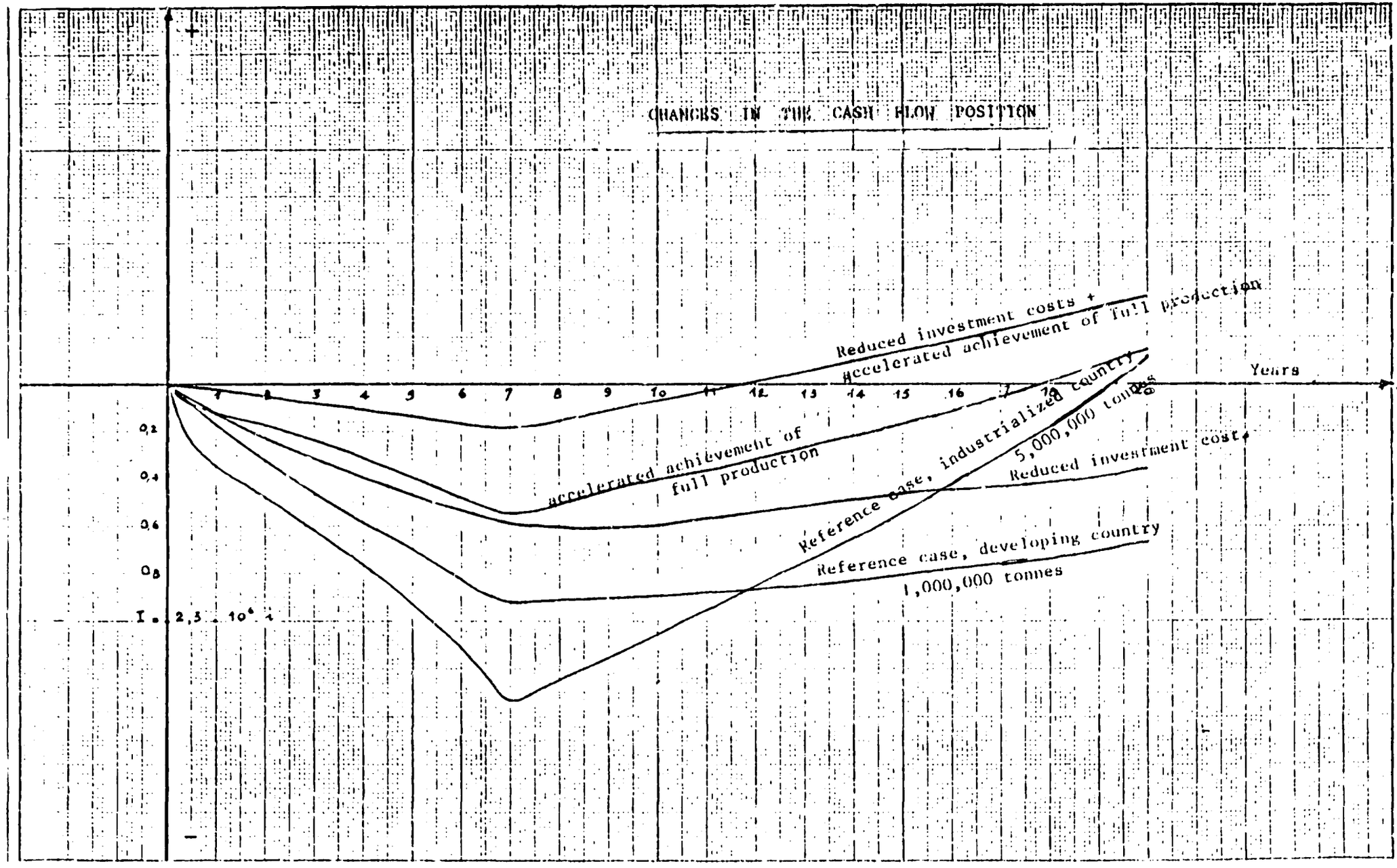
b) the rate of achieving full production in the developing countries is the same as in the industrialized countries, but the investment cost is unchanged;

c) the two previous favourable conditions are combined,

d) finally the case of the industrialized country where the rate of achieving full production is rapid, the investment cost is lower, and where the selling price of the iron and steel projects is more economic.

Analysis of these variants makes it possible to draw the following conclusions:

- the need to subsidize the massive cash flow requirements during the operational phase (this may reach the total investment cost);
- the necessity to find a system of tax holidays or subsidies to ensure viability of the project;


CHANGES IN THE CASH FLOW POSITION
+
−
Years
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
0,2
0,4
0,6
0,8
I = 2,5 . 10⁶ ₤
Reduced investment costs +
accelerated achievement of full production
accelerated achievement of
full production
Reference case, industrialized country
5,000,000 tonnes
Reduced investment cost
Reference case, developing country
1,000,000 tonnes

- the necessity to extend the duration of credit, particularly in the case of those developing countries with smallest resources;
- the necessity to link the reimbursement of borrowings to the rate of achievement of full production in the developing countries
- the gravity of the cash flow situation of iron and steel plants in the developing countries is the result of lack of adaptation of financing of the investment, of the high cost of the investment, and the slow rate of achieving full production, despite the high selling price of iron and steel products in the countries of the South.

I.2.7. Conclusions on financing

Obtaining financing for iron and steel projects is an essential condition when countries of the South decide to invest. In this sense projects of low capacity, directed towards changes in the international division of labour, are more favoured. However overall formulae for construction benefit from a favourable prejudice on the part of the financiers of the countries of the North. Generally speaking financial encouragements to export do not favour the national integration of equipment goods. Finally the duration of credits, and their level, are not suited to the special problems of the developing countries because of the slow rate of achievement of full production and the demands resulting from the high cost of the investment. Efforts made either to accelerate the rate of achievement of full production, or to reduce investment costs, considerably influence the financial needs in the operational phase. Furthermore by accepting a rate of credit of 8% over 7 years with a rate of inflation of 12% per year the industrialized countries which finance turnkey exports seem to be subsidising the buying country in the following manner:

let $Y = 1.33\ X$ be the relationship between the cost of turnkey and non-turnkey construction.

The interest advantage in the case of the turnkey formula represents:

$$0.85 \times 1.33\ X\ (0.12 - 0.08) \times 4 = 0.18\ X$$

This represents the net minimum excess cost for turnkey plants (excess profit + risks).

This observation tends to show that, through turnkey formulae, there is a transfer of subsidies from the industrialized country to the constructor and through the buying country, since the gain on the rate of interest granted to the purchaser must be compensated for by an excess cost to be paid to the supplier. In formulae involving engineering consultancy, by contrast, this subsidy seems to be partly retained by the buyer.

I.3. NATIONAL INTEGRATION

The structure of investment costs in the iron and steel industry is very valuable for appreciating the level of national integration in terms of volume, but it is important to locate the volume of equipment in terms of tonnage. In this respect it is accepted that, for an iron and steel plant with an annual capacity of 1 million tonnes of steel, the following tonnages of equipment are involved:

80,000 tonnes of production equipment, including 60,000 tonnes mechanical and 20,000 tonnes electrical;
80,000 tonnes of metal structures, roofing and facing;
13,000 tonnes of stocks of spares, including 8,000 tonnes specific spares, 2,000 tonnes standard spares and 3,000 tonnes general spares.

In economic terms equipment represents 50% of the cost of the whole, the remainder representing work on site. Spares represent 7% to 10% of the cost price of the product, but their unavailability is responsible for more than 50% of the loss of potential production in the developing countries. Taking into account the high cost of investment it is therefore necessary to analyse the prospects for integration with great care.

The iron and steel industry, as a supplier to the electrical and mechanical engineering industries, needs to promote activity in equipment goods during its realization phase, more particularly in the case of an iron and steel industry producing flat products.

In order to understand more clearly the problem of national integration and, more precisely, that of the manufacture of equipment goods in the iron and steel field, it is necessary to analyse the rôle of the following main actors:

- the engineering consultants,
- the supplier of equipment,
- the entrepreneur.

It is possible therefore to locate, in qualitative and quantitative terms, the various stages of integration of equipment goods into the iron and steel industry and, as a consequence, to evaluate the elements in a strategy for integrated development.

I.3.1. The engineering function

This has the following objectives, which assume the existence of special capabilities:

Objectives	Capabilities
- information research and processing	recording summarizing general, process and detailed design adaptation integration of national production, etc.
- management of construction and commissioning	establishing standards work programming site organization and coordination drawing up specifications control of building, acceptance, invoicing, inspection, reminders, etc.
- management of supplies	drawing up and managing the budget selection of suppliers buying, comparison of tenders control of manufacture, despatch, invoicing drawing up and following up contracts, etc.
- assistance to the client	preparation for decisions representation of clients' interests technical assistance during commissioning assistance in implementing production, maintenance and management organization administrative management: mandating, etc.
- adaptation to evolution	feedback of information from clients and suppliers liaison with applied research equipment producers and suppliers, etc.

The principal preoccupations of this function are regularization of the workload, the modernity of the design, development of the market and direct contact with the final client. This function is generally classified under general engineering, process engineering and detail engineering. Its rôle is essential, as we have already pointed out in the first study, in relation to:

- the selection of parameters,
- the degree of integration of the plant,
- the level of reliability,
- the choice of the process,
- adaptation of the equipment to the use of local materials,
- adaptation of the product to the market,
- the degree of sophistication,
- the volume of supplies,
- the origin of the supplies,
- the effect on the environment,
- the quality and time needed for construction,
- the quality of future production,
- the cost of construction,

to list only the most important points.

Simplifying, therefore, we may consider general and process engineering as being responsible for the design, for defining the process equipment, for drawing up the guide plans, for the general specifications for equipment and all the prime contractor functions. Detail engineering is responsible for the drawings, the detail installation drawings and more particularly in the following sections: civil engineering and earth works, structures, electricity, instrumentation, pipework, and metal fabrication. This distribution of the tasks allows us, by using the detailed structure of the investment costs, to locate the possible range of integration of local equipment goods in the various stages of development.

I.3.2. The function of the equipment supplier

It is necessary first of all to distinguish between equipment bought from a catalogue (current and standard products) and special equipment.

We are more particularly interested in the standard and special equipment which can be estimated, according to the structure of the investment costs, at 39% of the total cost, or 30% for production equipment, 6% for structural metalwork and 3% for spares.

The objectives for this function are as follows:

- research and development into new processes and materials
  - design
  - manufacture
  - testing
  - marketing
- design of equipment
  - adaptation to the client's needs
  - drawing up the calculation notes and selecting materials
  - drawing up the estimates
  - negotiation
- assistance to the clientele
  - documentation
  - training
  - technical assistance for production and maintenance
  - after-sales service
  - adaptation of the equipment
  - delivery of spares
  - manufacturing agreements for spares
- production management
  - buying, quality control
  - defining the list of work and the machine loads
  - programming
  - manufacture
  - sub-contracting
  - assembly
  - quality control, tests
  - despatch, erecting on the site, testing

The major preoccupations of the equipment supplier are:

- The work load, since fixed costs are generally high,
- Long-term developments in research,
- The correct evaluation of prices in regard to competition,
- The provision of financing for clients.

However he has many advantages, arising from the possibility:

a) of diversifying his manufacture as a result of the multipurpose nature of his production apparatus,

b) of sub-contracting manufacture in order to reduce fixed costs,

c) of effectively protecting his know-how.

Finally attention should be drawn to the rôle of the various major production routes for equipment goods for the iron and steel industry:

- structural metalwork, metal fabrication, heat-welding,
- forging, casting, machining,
- machining, erection,

which call on technologies of very diverse complexity. However whereas the levels of complexity in the last two routes are linked with the mastery of production management and technology, the complexity in the first route arises from product design(5).

Furthermore we must not forget the special problem of the production of spares which involves:

a) technological transfer,
b) training skilled personnel,
c) defining the production tools,
d) supplies of semi-products.

I.3.3. The enterprise function

The enterprise function can be subdivided into the realisation sub-function (civil engineering, earth works, etc.) and the erection sub-function. It is necessary in effect to distinguish these two sectors since their rôle differs. The realisation sub-function has the following objectives which call on special capabilities:

- commercial management
  - supplies
  - control of changes in basic costs
  - indexing prices
  - negotiating prices
  - understanding local conditions
  - invoicing
  - meeting delivery and budgets
  - guarantees on work

(5) UNIDO Position Paper on Equipment Goods. Algiers Seminar, November 1979.
IREP studies: Capital goods for the Iron and Steel Industry, February 1980
Transfer of Technology and Engineering in the Capital Goods Industry, February 1980.

- constructing a plant from drawings supplied by the engineering consultant or design office
  - estimating the volume of work
  - estimating the requirements in men and machines
  - programming the work
  - carrying out the work
  - immediate adaptation of the progress of work to the problems encountered:
    - weather conditions
    - lack of drawings
    - lack of materials
    - delays
    - non-availability of machinery, etc.
  - a priori estimation of costs either contractually or on invoices
  - control of progress, quality, cost, efficiency.

The hazards of construction, the quality of materials, the cost of materials, the delivery of drawings in quality and on time, and the productivity of labour, constitute the major preoccupations of the enterprise which in this way has to face up to permanent financial risks. The efficient utilization of its potential, and an accurate estimate of the volume and cost of the work, constitute the foundations of success. In the enterprise this know-how is located at the following levels:

a) costs,

b) possibilities of producing particular works,

c) the quality of the labour and compliance with deliveries.

The erection sub-function differs from the realisation sub-function in the nature of the tasks assigned to it. In erection the objective is the installation of materials and equipment, implying a detailed understanding of the latter, so as to allow their subsequent use. Whilst this function requires the same capabilities as the realization function it is generally closely linked to the supply of equipment function. The financial risks are, however, much lower, but each speciality demands skilled personnel, generally with considerable experience.

After having briefly studied the functions of the principal actors it is necessary to return to the Final Client who is responsible for promoting the national integration.

I.3.4. The rôle of the Final Client

Promoting the national integration of goods and services is fundamentally the rôle of the Final Client, but in reality it is very closely linked with the prime contractor. Therefore in formulae for turnkey or engineering consultancy construction mastery of this promotion is found in the rôle of the engineering consultant or assembler; experience shows many examples of conflict resulting from this dual responsibility. Consequently we must continue our analysis in greater depth so as to find possible solutions which could be integrated into the new forms of industrial agreement.

I.3.4.1. The objectives of the Final Client

The Final Client, in this study the developing country, may consider four types of objectives in regard to national integration:

1) national integration of the enterprise function;

2) national integration of the equipment goods production function -

   a) in the realization of the iron and steel project,
   b) in the production of spares,
   c) in the process of iron and steel production.

These objectives can be cumulative or, on the contrary, may be dissociated; they involve above all a political decision on the part of the planner and therefore constitute a factor in the overall development strategy. In this sense we cannot replace, in the appreciation of these objectives, the national policy-makers, but we can and should indicate the impact of their decisions on the iron and steel sector. Finally it is necessary to emphasize that the choice of one or more objectives is shown in the choice of a level of integration, for the objective(s) chosen, which is compatible with the choices of intersectoral planning.

Returning to the structure of investment costs in iron and steel we can translate, in a quantitative manner, the scope of the previous objectives. This expression takes the form of a percentage, in value, of the cost of the investment with, however, a reserve which we will subsequently formulate in regard to the utilization of the percentage of local money as a reference for the level of integration.

The first objective corresponds, at its maximum, to an integration equivalent to 25% of the total investment. The second objective involves, at its extreme level, an integration equivalent to 45% of the investment cost. The third objective corresponds to an integration equivalent to 3% of the investment cost, but also to total independence in respect of spares during the period of production. The fourth objective is more complex and less quantifiable; it involves the levels of real and national integration of the previous objectives but it is, above all, a function of the nature of the iron and steel production which is being envisaged. For example the production of flat products favours integration in equipment goods, whereas the production of long products tends to favour integration in the construction sector. Generally speaking the choice of the flat product route makes the integration of equipment goods in the structural and metal fabricating route possible, the more so since the nature of the product (steel or carbon steel) makes it possible to cover a large part of the downstream demand.

I.3.4.2. The possible stages

For the first objective the volume of the work, rather than the level of complexity, constitutes a constraint for national enterprises in the realization of an iron and steel project. For the second objective the increasing complexity of the manufacture of equipment goods creates a cruder progression in each of the production routes. Using the work of IREP[6] on this subject, and extending the breakdown by levels of complexity to the other items in the cost of investment, we can establish a total breakdown of the useful investment costs which can be used in an analysis of the level of national integration and the formulation of choices.

In this way we can define five typical objectives, corresponding to the various degrees of national integration. However in reality all the intermediate situations between state 1 and stage 5 can exist, since there is not necessarily, within any given country, any identity of level in each function. However this presentation in five steps has the value

(6) Capital Goods for the Iron and Steel Industry in the Developing Countries: UNIDO/ICIS November 1979.

of visualizing certain possible stages of economic development and of showing the corresponding "gaps". There is a complex relationship between the level of integration and the percentage of local money in the investment costs, since certain work services can call on local labour whilst still remaining directed by foreign companies.

It is possible to indicate a correspondence between the percentage of local money in the investment cost and the level of complexity as follows:

level of complexity	1	2	3	4	5
Investment cost	15%	40%	70%	95%	100%
Percentage local money in the investment cost	30%	50%	75%	95%	100%

This purely indicative correspondence only applies in the case where the Final Client genuinely exercises his rôle as the promoter of national integration. In the opposite case the percentage of local money is considerably reduced, as in the case of turnkey projects.

It is interesting to associate the typical formulae for realization with the level of complexity; in this way it would appear that:

a) formulae for an overall realization of the turnkey type often reflect a national technological activity of types 1 or 2,

b) formulae for realization with foreign or national engineering execution capabilities reflect an activity of types 2 or 3,

c) formulae of realization with full national engineering capabilities are often associated with an activity of types 3, 4 and 5.

In the process of integration it would seem that there is a progression from the carrying out of work up to the manufacture of equipment goods. The development can be as follows:

ITEMS \ LEVEL		1	2	3	4	5 hard core	TOTAL
Equipment + spares + misc.	Metal fabrication Heat welding		2.5%	3.5%	3.5%	1.5%	11%
	Casting Forging		2.5%	1%	7.5%	2%	13%
	Electrical		0%	4.5%	3%	1.5%	9%
	Structural		3%	3%			6%
	Elementary parts		2%	2%	2%		6%
Sub-total			10%	14%	16%	5%	45%
Services	Training				1%		1%
	Commissioning			2%	2%		4%
	Transport	1%	1%				2%
	Engineering		2%	4%	4%		10%
Sub-total		1%	3%	6%	7%		17%
Work	Civil engineering	3%	7%	7%	1%		18%
	Erection		3%	2%	1%		6%
Sub-total		3%	10%	9%	2%		24%
Miscellaneous		1%	2%	1%			4%
Taxes		10%					10%
Total		15%	25%	30%	25%	5%	100%
Cumulative		15%	40%	70%	95%	100%	100%

Civil engineering, erection, and the manufacture of equipment goods, following the route: structural metalwork, metal fabrication and heat welding, then the route: casting, forging, machining, finally the electrical route, then arriving at the final phase of the "hard core". The previous stages 1 to 5 are characteristic of the following phases of integration:

	Integration policy followed	Integrated activities	Example
Stage 1 30%	- utilization of overall realization formulae - no desire for integration ("laisser faire" policy)	none, apart from making local labour available	
Stage 2 50%	- promotion of national activity - utilization of national engineering formulae - creation of national engineering capability, limited to execution studies - assistance of foreign design offices to national plants manufacturing equipment goods (structural, banks, etc.) - identification of agreements for the manufacture of spares - research into the integration of iron and steel products, (sheet and plate, tubes, profiles, etc.)	- civil engineering - erection (cabling. painting, etc.) - structural metalwork, simple metal fabrication - manufacture of elementary spares - common goods	Algeria
Stage 3 75%	- policy of intersectoral integration, giving priority to the production of national equipment goods - existence of an experienced national engineering capability, but absence of process engineering - standardization - realization by mixed engineering formulae - valorization of existing iron and steel know-how - negotiation of manufacturing agreements with different producers: subsidiaries, licencing, sub-contracting, etc. - policy of financial support and customs protection for national equipment goods	- the above totally, plus, partially: - heat welding - casting, forging and machining route, - electrical route	Brazil

	Integration policy followed	Integrated activities	Example
Stage 4 90%	- total integration of the engineering function - desire to export the engineering activity - desire to export equipment goods - implementation of engineering structures in all the sectors - greater attention given to the problems of costs of the goods produced - negotiation of specialization agreements (range, region, etc.) with licence holders - radiating technological policy	the previous totally, excluding the hard core: Equipment integrating highly advanced know-how in regard to: - product design - product manufacture	India
Stage 5 100%	highly industrialized countries	within the framework of the international division of labour	

I.3.5. CONCLUSIONS

National integration depends essentially on the rôle exercised in the matter by the Final Client. The various forms of realization obviously influence the degree of integration, and the possibilities of integration affect, for this reason, the currency balance of the investment. Finally it must be recalled that budgetary constraints, delays, and financing may reduce the desired level of integration. It is consequently necessary to accept that, as a function of the challenges in the iron and steel field, the desire for integration must above all be expressed by the political power and be integrated into an overall development strategy. The various steps indicated above are characteristic of the existing situations in various developing countries. However the size, the resources, the level of

development and the iron and steel prospects define, for each of these countries, the probable limits of long term integration. The passage from one level of complexity to another level is therefore the result of a political desire, depending on an appreciation of the various economic operators. Only pressure from the Final Client can favour this integration. The orders of magnitude of tonnages, indicated above in regard to equipment and spares, show that one can define a policy of integration according to the approach through the sector of specific goods, or according to a multi-sectoral approach for joint and standard goods. The sectoral engineering function therefore makes it possible to open the "technological packet" content in the equipment goods for each sector. The approach from upstream, and hence via the iron and steel industry, defines the optimum range of semi-products as a function of their utilization by the downstream sectors, and in this way suggests an inverse but complementary process of integration. Finally the question of reflection on the problems of manufacturing spares, in the iron and steel project, as a factor in increasing reliability and subsequent management, must not be overlooked.

I.4. ACHIEVEMENT OF FULL PRODUCTION

Achievement of full production is a transitory stage located between the constructional phase and the phase of mastery of production. Its success is essentially a function of the level of development achieved by each of the partners, of the quality of design of the project, of the quality of the supply, and of the efficient transmission of know-how. The achievement of full production is a test which will result, as a function of the results, either in trauma or in success for the partner receiving the technology. The financial result, because of the magnitude of fixed costs, will be directly influenced by the efficient rate of achieving full production. This period of greater or lesser cooperation has, up to the present time, remained beyond the scope of any objective analysis to the point where the opinions of partners become passionately partisan.

We will study, successively, the influence:

- of the environment of the partner in the developing country
- of the mode of realization
- of the quality of the design
- of the quality of technological transfer.

I.4. THE INFLUENCE OF THE ENVIRONMENT

The environment of the country constructing an iron and steel plant plays an important rôle in the success of the technological transfer, and hence in the success of the achievement of full production. The Nation and the State must be conscious of the importance of the technological transfer in the process of development, and be convinced that the degree of penetration of the techniques is proportional to the level of development of the country. A technological graft onto a poorly prepared stock has little chance of success and is felt as aggression against the traditional cultural values. Appreciation of the rôle of technological transfer by the technocratic strata alone is interpreted, in the eyes of the popular masses, as an external compromise and a move towards increased external dependency. The political ideology of a country which does not integrate technological support into its political, economic, social and cultural analysis can turn out to be a powerful brake on development. However, on the other side, the understanding of the virtues of technology as the sole vector of development is a technocratic vision, and hence essentially limited and unfruitful.

From another point of view the success of technological transfer is linked to the implementation of minimum social conditions to ensure stability and intellectual freedom for those responsible for the undertaking. An industrial realization which is not accompanied by meeting needs for accommodation, transport and socio-cultural activities will result in a rejection of industrialization in the collective mind of workers and citizens. Over a long period it is not possible to hope both for the acceptance of austerity by the workers and the continuance of their effort in technological acquisition. In addition to the social conditions which need to be combined together a wages policy, linked with the improvement of productivity, is essential if the workers are to pursue their efforts collectively.

Finally teaching must take account of technological reality in its programmes, must integrate practical training, and must facilitate the absorption of the young into the working world by practical stages. Attention must be given to three points in teaching:

- utilization of theoretical concepts in the activities of normal life; the search for information, its processing and its utilization in decision-making,
- training in shift-working
- the support of men of experience, experienced in defining teaching programmes.

Achieving full production is therefore facilitated by the existence of the above conditions in the investing country.

I.4.2. The influence of the mode of realization

Achievement of full production is profoundly influenced by the quality of the cooperative relationships between the engineering consultants, the equipment suppliers, the owner of the know-how and the Final Client during the construction phase, the commissioning phase and, finally, the start-up period. In this way forms of realization which a) do not create these relationships as a result of the lack of appropriate executives or b) ignore them during one of the previous periods or c) do not involve one of the protagonists or d) create barriers between the partners, are generally harmful to the success of reaching full production. Forms of overall realization have a natural tendency, in the absence of special arrangements, to exhibit this type of fault. Formulae with engineering consultancy, more open to the Final Client, should allow realization of the previous conditions. Finally it is necessary to accept that, in the latter type, the Final Client, being more intimately linked with the decisions, becomes accustomed to the different partners at the constructional stage, and in this way acquires valuable experience. This seems to follow the following cumulative process: the more iron and steel experience the Final Client possesses the more he desires to have an associative form of realization; if technological understanding is therefore improved the achievement of full production takes place more rapidly.

Forms of overall realization have, psychologically, the defects of ignoring the Final Client during the phase of construction whilst they necessitate fairly sustained participation on the part of the latter in formulae involving engineering consultancy. These trends being noted

it is nevertheless necessary to emphasize that appropriate arrangements made in the classical formulae for overall realization can eliminate the weaknesses indicated above.

I.4.3. The influence of design

The quality of design of the unit is a fundamental factor in the success of achieving full production. Cooperation between engineering consultancy, supplies, iron and steel producers and the technical level of the partners predetermine the value of the design and the success of the achievement of full production. We will analyse successively four aspects of this problem:

- the content of a good design,
- the impact of the mode of realization,
- the rôle of the holder of the know-how,
- the adaptation to local conditions.

I.4.3.1. The essential content of a good design

In the iron and steel industry two special factors influence the value of the design:

- the large tonnage of heavy products,
- the high thermal consumption.

Therefore the designer of an iron and steel project must give his full attention to the following general studies:

the basic plan,
the materials balance sheet,
the circulation of products,
the positioning and areas of the storage zones,
the careful distribution of capacities and excess capacities,
the transport plan,
the safety plan,
the circulation of fluids,
the definition of the extension zones,
the storage of waste products,
the protection of the environment,
the possible energy economies.

In the detailed preliminary project the drawing up of the technical specifications must be based on criteria of reliability, simplicity, robustness, efficiency, modernity, safety and economy.

I.4.3.2. The impact of the mode of realization

The quality of the design obviously develops from the overall study of the project up to the definitive detailed study. At the same time budgetary estimates are refined with the accuracy of the study: formulae for overall realization have a tendency to fix the technological content of a project well before the establishment of the detailed studies. The corresponding budgetary estimate makes it possible for the assembler to establish his prices from the point of view of the subsequent negotiations. At the level of the final contract the prices and the technical content which have been negotiated are definitively fixed. These two constraints can weigh heavily subsequently if the partner, as a result of inadequate know-how or inadequate references, has designed his project badly. As a consequence in formulae for overall realization of the turnkey type greater attention must be given to an evaluation of the design capacity of the turnkey supplier; the more so since this is not evident in the case of a tenderer who is originally a supplier of equipment or entrepreneur. In formulae involving engineering consultancy the risk of error exists, but the very nature of the engineering consultancy function means that it is exposed to less risk. Furthermore the progressive progress of the studies under the control of the client makes easier corrections possible, since the financial consequences do not result in conflicts as in many cases of overall realization.

I.4.3.3. The rôle of the holder of the know-how

We must not underestimate the rôle of the holder of the know-how in the quality of the design; firstly the holder of the know-how is not systematically identified with the engineering consultant or the supplier of equipment in the field of mastery of production (software). As a general rule the engineering consultant or the assembler are organically associated with the iron and steel producer, but this does not necessarily imply the intervention of the latter in the control of the studies and supplies made by the others. The Final Client must

therefore organize either associated integration of the assembler with the holder of the know-how, or assistance in the form of advice from the iron and steel producer himself.

I.4.3.4. Adaptation to local conditions

The local conditions considered are raw materials and consumables, fluids, supply conditions, the possibility of local supplies of goods and services, the local infrastructure including transport, social and accommodation, the possibilities of sub-contracting, the possibilities for maintenance, commercial habits, the conditions of distribution of the products, the general technological level, the level of the iron and steel industry, the local conditions for recruitment and training, the conditions for receiving technical assistance personnel, and political objectives in regard to employment.

All these conditions, although often qualitative, do not figure explicitly in the data of calls for tenders. There is a considerable temptation, for the designer, consciously or unconsciously to ignore certain elements so as to facilitate the design study by extrapolation from data valid in a technologically developed environment. The errors subsequently observed are expensive, and often can not be effectively corrected.

A number of the difficulties of plants in the developing countries are of design origin, either

a) as a result of the lack of studies adapted to local conditions, or

b) as a result of the poor definition of the limits of intervention of the designer, or

c) as a result of negligence.

The preliminary project must therefore be drawn up taking into account the local conditions, using experienced, mobile and open-minded designers: the design team must be partly maintained on the project up to the end of achieving full production so as to allow any modifications which become necessary at the commissioning phase.

I.4.4. The influence of technological transfer

Progress towards full production is a test in which the Final Client, assisted by his partners, progressively assumes operational mastery of the installation. It is therefore essential that the technology has previously been transferred to him, and continues to be transferred during this period, so that he becomes fully the master of the installations. Three fields must be the subject of the transfer of technology:

production, maintenance and management.

Personnel must therefore acquire individual training, collective training, static as well as dynamic knowledge of the installation, an understanding of organization and the distribution of work on the site, discipline and initiative, apprenticeship and the mastery of the technical system, the concept of equipment preservation and, finally, awareness of the problems of costs.

Many works deal with these problems with considerable ability, but they do not appear to give the necessary attention to the following points:

- the principles of organization of the progress to full production,
- the role of documentation in technological transfer,
- the importance of spares.

We will be studying these successively.

I.4.4.1. Organization of the achievement of full production

In the industrialized countries, or in countries which are becoming industrialized, the problems of organization and management do not have the same centre of interest, but they can be approached by a methodology of the same type; it is necessary to identify the limits of the problem, to seek its cause, to discover the solution or solutions, to select the solution, to estimate the time required, to identify responsibility for the action, to control the carrying out of the action and to check the results of the operation. This process, obvious in an industrialized country, must be explained more clearly by way of the mode of organization in the developing countries. Industrial management tools must be adapted to allow apprenticeship in industrial reflexes: rapid decision-making and efficient action. In the hazardous start-up period such an organization makes it possible, using tools of this type, to establish a logical reference framework for decision-making. The danger arises from expatriate personnel having considerable practical experience which reacts unfavourably to the implementation and utilization of such teaching tools, since the process broken down in this way has become a reflex for them.

It is also necessary, in this phase of reaching full production, to identify what still remains to be accomplished and to remove, by way of a logical approach, the successive bottlenecks so as to avoid the fatalistic attitude towards industrial start-up and ignoring failures or lack of success outside one sphere of responsibility. This approach therefore leads to using the previous tools in such a way as to collect valuable information in the decision-making process, rather than for establishing statistics. The principal merit of this method is that it can involve different structures in the process. For this reason it involves even greater responsibility, since:

a) the indication of the economic challenges allows priority ordering and action,

b) cooperation between structures will be more easily achieved.

The organization must be designed for the needs of each structure and each level of responsibility on the basis of the process described above so as to develop decision-making and action progressively in the form of reflexes.

Finally, in this organization, the industrialized partner must assist in the progressive installation of the following essential services which definitively consolidate mastery of production: programming, quality control, methods and new works offices, internal training and the identification of new products.

I.4.4.2. The rôle of documentation

Documentation forms an important support for technological transfer. The information handled is retained, is available, and must be updated; it may be intended for the constructional phase or the production phase; for this reason it constitutes a base for the acquisition of know-how in building and production. Without claiming to draw up an exhaustive list it is essential to be able to accept and store the following documents:

Constructional documents	drawings calculation notes technical notes technical specifications site and inspection reports test reports progress reports critical path planning

Operating documents:
- descriptive manual
- operating manual
- utilization manual
- maintenance manual:
  - preventive
  - trouble-shooting
  - repair
- catalogue of spares
- recommended list of spares
- catalogue of prices, list of sub-contractors, etc.

I.4.4.3. The importance of spares

Technological transfer in the industrial field includes the ability to master the problems of maintaining equipment. It is not therefore surprizing to look at the problem of spares within the framework of technological transfer. In fact, as we have already pointed out above, this factor is involved in more than 50% of the causes of losses of potential production. Therefore obtaining drawings and constructional notes of spares from the equipment supplier, like the implementation of an adequate infrastructure of maintenance workshops, will considerably favour the stability of production.

The developing countries must be able to be certain of the efficient realization of these two conditions so as to guarantee their own technological mastery with the least external dependence.

I.4.5. CONCLUSIONS

Summarizing, therefore, success in achieving full production depends on the technological level and the political, social and cultural conditions of the investing country, but it is essentially a function of the quality and the extent of the cooperative relationship between partners, of the quality of the basic design, and of its adaptation to local conditions. In order to ensure the success it is essential that technological transfer be organized which results in a process of increasing mastery of decision-making and action. Extensive documentation, accompanied by facilities for local production of spares, considerably increases the chances of success in achieving full production.

I.5. MANAGEMENT

This point will be studied briefly here, since our previous study and previous developments have devoted much space to factors influencing management. We will only consider the economic factors in what follows. The structure of the cost price may evolve in the following manner between now and 1990 in the industrialized countries according to certain studies which have been personally completed(7).

per tonne rolled steel in 1975	1980	1985	1990
Operating cost	200 (69%)	205 (64%)	200 (57%)
Capital cost	90 (31%)	115 (36%)	150 (43%)
Total cost	290 (100%)	320 (100%)	350 (100%)

In the case of the developing countries the capital cost will, obviously, be higher because of the higher cost of the investment and the low level of utilization of the production capacity; furthermore the operating cost will be higher because of lower productivity in materials and because of the fixed charges (personnel, etc.). Management of plants in the developing countries risks being heavily penalized by:

- the financial cost of loans and lack of cover,
- the high investment costs,
- the low material productivity,
- the low utilization of production capacity,
- the relatively full size of the plant (flat product route).

In consequence, and in plants producing flat products, efforts must be made to improve the production potential, to increase the size and to select the forms of realization which are most economic. In the case of plants producing long products efforts must be concentrated on the utilization of the production capacity and on the least difficult technological choices.

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(7) IRDB: Prospects for the World Iron and Steel Economy: The wise model.

Finally stability in terms of the quality, price, quantity and regularity of supplies is a beneficial factor in management, as is also the stability of previously trained personnel.

I.6. CONCLUSIONS

During this lengthy analysis of the factors involved in the success of an iron and steel operation we have observed considerable interlocking of the factors. An understanding of these interactions has the advantage of allowing a subsequently more coherent formulation of a contract for development in the iron and steel sector. Finally the diversity of the situations in the developing countries, apart from being a handicap to this formulation, can easily be taken into account when using our approach.

II) THE NEW INDUSTRIAL AGREEMENTS

At the conclusion of the previous analysis, and taking into account the conclusions of our first study on industrial agreements, it seemed advisable to regroup all the conclusions so as to test their coherence. The resultant lines of force make it possible to structure the new forms of industrial agreement.

II.1. Summary of the conclusions

The first study involved specifying the principles and the methods for constructing the new industrial agreements, whilst the first part of this study has made it possible to define the specific objectives in the iron and steel sector which should be integrated into these new agreements.

FIRST STUDY	1) Principles of the method - interdependence, diversification, mutual benefits, equilibrium, stability - long term - differentiation according to the situation 2) Content of the method - structuring the agreement around engineering, producer, equipment suppliers - definition of counterparts - progressive objectives: balancing the neutralization of dependence
SECOND STUDY Investment cost	Reduction of cost: - by size effect (flat product route) - by technological choices (by continuous casting, direct reduction, spirally welded tubes, barge-mounted plant, etc.) - by reduction or suppression of the multiplying coefficient: - rejection of overall formulae - acceptance of local risks by the client - enlargement of competition by size reduction - detailed basic studies

Financing	- relative facility of financing of small scale projects, hence the advantage of the long products route and direct reduction - extension of time for credit - linking reimbursement of loans with the rate of achieving full production - pseudo-advantage of overall formulae - financing subsidy transferred to the assembler - necessity to determine an adequate, complete and economic financing structure
National integration	- importance of the responsibility of the Final Owner - the external financing requirements shackle national integration - overall formulae do not favour national integration - necessity to create engineering capabilities (detail, contracting, process) - despite the low value of spares their economic impact should encourage greater integration of their manufacture - diversity of situations of the developing countries which can be divided into five steps of progressive development - integrated part of an overall development strategy
Achievement of full production	Favourable factors: - quality of the political, social and cultural environment (quality of teaching, technological understanding) - quality of the basic design - structured relationships for the various partners - adaptability to local conditions - teaching and dynamic organization - quality and volume of documentation - local manufacture of spares
Management	Previous conclusions: - reduction of investment costs - adaptation of financing period, cost and subsidies - efficient achievement of full production - stability of the production by local manufacture of spares New conclusions: - stability and guarantee of materials supplies - improvements in productivity - stability of personnel

The previous conclusions justify, a posteriori, the basic principles of our study:

- necessity for a new form of industrial agreement
- necessity for cooperation based on the long term
- necessity for a method for defining the type of industrial agreement:
  - . adaptable to each developing country
  - . adaptable to the various technological choices.

From these conclusions can be seen the following additional lines of force.

1) Overall formulae for realization, in the existing form, are unsuited to the developing countries.

2) The conventional flat products production route is difficult for developing countries because of scale effects, the financing needs which result, the technological difficulty and the nature and volume of the demand.

3) The link between the iron and steel industry and equipment goods can only be established as a function of political desire and with a coherent development strategy.

4) The concept of a counterpart becomes a great necessity for balancing industrial relationships in the iron and steel sector.

The industrial agreement must, as a consequence, be constructed on a long period with an adequate system of counterparts, and taking into account the development of the sector. The partners should evolve according to their rôles and defined responsibilities, whilst state guarantees should ensure the quality and extent of the cooperation. In such a system the excess costs should leave a place for formulae involving premiums linked to realization of the intended objective; export subsidies should not be used incorrectly; the holder of the know-how should be encouraged financially to participate in the operation. Finally the sharing of risks should be more natural between the partners.

The particular technological choice of the flat products route, being seen as a stage towards a more integrated production of equipment goods, should, as a consequence, and from a long-term view, open up greater possibilities for the integration of local goods and services in the industrial agreements.

All these factors, as defined within the framework of our method, lead to putting forward the possible subjects for a development contract. However the diversity of the situations does not make it possible to examine all the possible forms, so we will develop the bases which are common to these various types.

II.2. THE DEVELOPMENT CONTRACT

The new form of industrial agreement involves the necessity for fundamentally revising the conventional rules for consultation, and of integrating the general and specific conclusions resulting from the sectoral application of the method.

II.2.1. THE NEW FORM OF CONSULTATION

It is possible to imagine the application of the method to all the economic sectors; this results, for each sector, in a list of the possible partner countries. The overall aggregation makes it possible, with the political and economic criteria, to determine the pairings between sectors and partner countries. The analysis obviously requires a prior understanding of the potentialities of each country, the actors and their strategy in each sector. Consultation can therefore take the form of a discussion at diplomatic level, subsequently resulting in a governmental agreement as the basis for a development contract. Finally the various partners concerned could negotiate the whole of the elementary contract either separately or taken overall. However other approaches remain possible, either a) on the basis of industrial partners wishing to cooperate between themselves, and attempting to convince their respective governments of the need to create a basis for cooperation or, b) on the basis of contacts between a developing country and enterprises of various nationalities. In these latter approaches governmental base agreements remain necessary to guarantee the sectoral development contract.

The statement of these different types of approach shows that they are not new; they are frequently used either by the communist countries or by the market economy countries in privileged relationships with developing countries. By contrast, and what is less common,

is the use of a method of analysis and forecasting for the determination of a coherent policy for economic cooperation. This process may lead, in certain cases, to suppression of the competition from the suppliers, and therefore it is necessary to take the precaution of establishing, as a preliminary, various studies which make it possible to arrive at a fair approximation of the construction costs. It is important therefore to retain two fundamental points in these new consultations, irrespective of their form:

1) the need for contact between the governmental authorities at an initial stage with a view to testing the reciprocal desire for a new form of cooperation,

2) the need to establish relatively detailed studies on the list of equipment and their cost.

The development contract would then be the expression of governmental wishes and the desire to establish a beneficial cooperation based on the exchange of a quantum of development against natural or financial resources.

II.2.2. THE CONTRIBUTION FROM THE INDUSTRIALIZED COUNTRY

Before studying these contributions in a detailed manner we should point out the importance of the political and economic wish in the success of cooperation, particularly when it involves North-South relationships. Demagogy, paternalism, misunderstanding or indifference cannot at any time serve the cause of cooperation. On the other hand a respect for differences, the acknowledgement of cultural diversities and a loyal acceptance of the coexistence of different ideologies, with the desire to establish long-term beneficial relationships, are powerful stimulants for balanced cooperation.

These preliminaries having been stated we can return to the specific contributions which are possible from an industrialized country in the iron and steel industrialization of a developing country.

II.2.2.1. Investment costs

The unit investment cost per tonne of steel is highly dependent on the following factors:

- size of the plant (in the case of flat products),
- technology,
- mode of construction,
- basic studies.

As a consequence it is important that the negative influence of factors causing very high investment costs such as, for example, the construction of a small-capacity plant for flat products using an overall construction formula, should not become cumulative. Various solutions are possible in the short and in the long term for remedying this situation, in particular:

a) the development of associative construction formulae aimed at reducing investment costs, mixed engineering and sufficiently detailed basic studies to allow the direct assumption of local work by the developing country, calling on international competition to obtain the most economic equipment costs, choosing the most economic technologies such as continuous casting, direct reduction, spirally welded tubes, barge-mounted plants, etc., together with the efficient utilization of local possibilities.

b) the development of technologies which make it possible:
   1) to extend production ranges, so avoiding proposed new investments,
   2) to use common iron and steel semi-products more extensively.

c) in the particular case of the flat products route increasing the size of the plant can improve profitability, with the possible exporting of the surplus using the commercial assistance of the partners in the industrialized countries.

The countries of the North must therefore offer, in a development contract, better investment costs, assistance in the mastery and development of the selected technology, and a method for acquiring the technology. To a certain extent this presupposes the implicit acceptance by the partner in the industrialized country of:

a) converting the investment excess cost into a premium, possibly linked with the success of the cooperation,

b) seeing the iron and steel industry of their client develop as a result of their assistance.

II.2.2.2 Financing

The financing of iron and steel projects in the developing countries must be the subject of substantial improvements, both in respect of the volume and also the conditions of credit. It is necessary, consequently, that:

a) the reimbursement of loans should be linked with the rate of achievement of full production;
b) the total credit allows:
   1) financing of local expenditure, or at least the financing of the indirect currency for the project,
   2) partial financing of the start-up expenses;
c) the rate of credit should be penalized in the event of slow achievement of full production.

In fact the industrialized country expects through the financing of exports to promote its exports by offering privileged conditions as compared with the domestic financial market. For this reason it is necessary to link the quality of the exports to the mode of credit. It is certain that this point of view will not please the financiers, but it is necessary to be clear on the matter: as long as the methods of reimbursement of credit for projects is divorced from proof of efficient operation, the indebtedness of the countries undergoing industrialization can only increase. In this way the international division of labour guarantees the permanence of positive financial flows to the industrialized countries. To understand this more fully it is only necessary to return to the previous conclusions on financing in paragraph I.2.7.

For a country on the road to development it seems to be preferable to accept export credit at the market rate if the rate of achievement of full production is satisfactory, rather than to reimburse export credit at a privileged rate with poor achievement of full production.

It is not, however a question of proposing raising the rate of interest but rather of emphasizing the achievement of full production as an important and significant fact in solving the financing problems of the iron and steel industry.

The industrialized country, accepting the principles set out above in the development contract, implicitly guarantees its capacity to organize the work of its organizations and companies so as to ensure the success of this cooperation, but it also confirms, to a certain extent, its confidence in its partner, since the latter is the recipient in this responsibility for success.

II.2.2.3. Integration

The responsibility of the partner in the developing country is essential when defining the success of a policy of integration. The partner in the industrialized country can only assist or hinder in the exercise of such responsibility. The factors exercising a positive influence for the developing country are the existence of engineering capabilities, the rejection of overall solutions, and the financing possibilities; but, as we have already seen, the diversity of situations in the developing countries does not make it possible to define universal rules. However we may retain the following subjects as worthy of finding a place in the development contract:

a) participation of local plants and enterprises in the construction, according to a list of work, materials and equipment goods to be supplied, and according to a time-table of exchanges of information between the various partners;

b) assistance from the partner or partners in the industrialized country, consultants, equipment suppliers or holders of know-how, to the partners in the developing country, with a view to promoting national activities in the following fields:
   - spares,
   - utilization of the products of the iron and steel plant,
   - passing from one level of integration to a higher level.

The second subject obviously assumes progress in time. Cooperation, in these fields, can result in long-term associations or take the form of supplying services (licensing, technical assistance, training).

The elements which are unfavourable to a policy of integration. such as lack of financing, higher cost, and risks of delay, must be discussed beforehand between the partners so as to avoid any subsequent conflicts. Finally the contractual objective must be agreement on a precise list of local equipment to be integrated into the iron and steel project, not a pseudo-agreement on a level of integration.

In this way the various partners become conscious of the true challenges and can prepare for these with the greatest hopes of success.

II.2.2.4. Achieving full production

Amongst all the factors favouring the achievement of full production a number are under the control of the partners in the industrialized countries:

- quality of the basic design and its adaptation to local conditions,
- quality of the organization for the achievement of full production,
- structuring of the relationship between the partners in the various countries,
- quality of the documentation and transfer of techniques for manufacturing spares.

This involves, as a consequence:

a) the selection of a good engineering company with adequate references,
b) the choice of a holder of know-how who is completely master of the iron and steel field,
c) the choice of equipment suppliers with excellent reputations,
d) the implementation within the development contract of an institutional framework of relationships between the partners,
e) the organization by the partners of the detailed and programmed content of the technological transfer.

These conditions must be fulfilled by the industrialized countries in order to guarantee success. In no way can these contributions be reduced or compensated for by other contributions such as the size or financial power of one of the partners in the industrialized country.

II.2.2.5. Management

In this ultimate phase the industrialized country can offer, within the frame of a development contract:

- stability in terms of quantity and quality of supplies of raw materials (e.g. coke) and, if necessary, of spares;
- assistance in the improvement of productivity, both material and human;
- assistance in the development of new products, or in the utilization of materials of local origin;
- assistance in the improvement of economic management:
- where necessary, assistance in exporting iron and steel products.

These conditions therefore require, for their realization, long-term relationships between the partners.

Faced with all this support from the industrialized country it is essential, if interest is not to be lost, that substantial counterparts be proposed which allow it to retain a sustained and active interest throughout the entire period of the contract.

II.2.3. COUNTERPARTS FROM THE DEVELOPING COUNTRIES

In this field it is of value to recall the following findings:

- technological transfer is not limited to the single operation of constructing a plant,
- without adequate counterparts in terms of remuneration and effort, technological acquisition requires much time in the countries of the South.

Therefore it is with method, conviction, patience and will that the effort for acquiring technological transfer must be organized. From this point of view the choice of partners for the developing country should not be based exclusively on technical or financial criteria. As we have already emphasized in the conclusions of our previous study, the technology/money exchange is not the one which is best adapted to the developing countries: it often leads to a feeling of disillusion and frustration on the part of the countries of the South in regard to technology. Prior understanding of the real possibilities of the partners from various industrialized countries, their references in the countries of the South, and the quality of their technological mastery, together with a real desire for cooperation on the part of each of these countries and the system of counterparts to be offered, constitute the basic information which is necessary when finding the eventual partner or partners. On the basis of this, then by methodically defining the objectives to be achieved, and having previously carried out basic studies which are as detailed as possible, it is possible to approach the phase of negotiation with the maximum guarantee of success.

The possible counterparts are unfortunately not very numerous for the developing countries; certain of them have been pointed out already, others can be implemented on the basis of mineral resources or starting from the medium-term requirements for equipment goods.

II.2.3.1. Local Risks

The financial acceptance of local risks, provided that these have been defined and specified in the detailed studies, should be the responsibility of the Final Client. This provision has the following advantages for the latter:

- the removal of provisions for risks by the constructor,
- appreciating and solving national problems causing blockages (bureaucracy, shortages, etc.).

Experience shows a trend towards more long-term flexibility in settlements and better internal planning when the partner in the developing country is responsible for solving local problems (transit, transport, Customs clearance, etc.). We must not fail to emphasize that this provision has the unfortunate defect of being used by unscrupulous suppliers, in the event of disagreements, to explain delays or possible financial losses. From this point of view it is prudent to establish, in a clear manner, the list of risks covered and the financial penalties falling on the Final Client.

II.2.3.2. Premiums

The system which we propose is of no value unless the contributions from the industrialized country are effectively carried out; several possibilities then exist for remunerating their services:

- either a financial premium;
- or long-term delivery of a strategic material at a preferential rate;
- or a long-term commercial agreement:
  - . on iron and steel products,
  - . on certain equipment goods.

In order to implement this system it is necessary first of all to define a system linking the premium to the realization of objectives; it is possible to conceive schemes which are increasingly complex, but we would simply like to indicate some essential points which are capable of being utilized as the basic objectives:

- the achievement of full production;
- the manufacture of spares;
- the improvement of productivity and management;
- increased integration:
  - . of the engineering sector,
  - . of the sector using the iron and steel products,
  - . of the sector manufacturing equipment goods.

Each of these previous actions constitutes a special test which, in the event of success, triggers off a system of premiums. Weighting of the premium can be fixed arbitrarily, or may be the subject of economic calculations for each significant event. The duration and size of the premium obviously depends on the number and size of the intended objectives, and consequently will influence the choice of the remuneration formula.

The following examples will serve as an illustration of the timetable:

Years 1 to 3
- raising production from 0 to 100% of the production capacity,
- implementation of a mixed engineering structure;

Years 3 to 5
- improvement of physical productivity,
- mastery of programming, quality control, methods office and other sectors,
- local manufacture of spares;

Years 5 to 7
- improvement of management,
- research into and utilization of local materials to reduce import costs;

Years 7 to 10
- development of new products,
- customer assistance;

Years 10 to 20
- supply of raw materials,
- integration of specific equipment goods.

II.2.3.2.1. Financial formulae

It is possible to conceive several types of solutions which are increasingly generous. In fact, if it is recalled that the acceptance of local risks is now assumed by the Final Client, all provisions for risks in the overall formulae for construction disappear, and part of this sum can be reserved for a system of premiums. The excess costs,

or financing premium (the difference between the market rate and the rate of credit) may also serve as a basis for the determination of the premium. This financial formula is therefore linked to the realization of the objective laid down in a timetable, but it has the defect of imputing the corresponding expenditure to the iron and steel project.

II.2.3.2.2. Formulae for selling at preferential rates

In the analysis of strategic mineral or agricultural needs the developing country may possibly discover, in its resources, a potential for supplies, and may offer a guarantee of supplies of a raw material at a preferential rate; the corresponding return, being linked to the realization of fixed objectives, may be cumulative or, on the contrary, may be re-examined for each objective. The duration of these supplies and the volume of deliveries are therefore defined as a function of fixed objectives and the total currency costs of the iron and steel investment. The advantage of such a formula is that it leaves the partner in the industrialized country responsible for the redistribution of any premiums between the national operators.

II.2.3.2.3. Formulae for commercial compensation

Formulae for commercial compensation attempt to implement a flow of trading of products which will not be manufactured by the countries of the South for a long period. These products can relate either to the iron and steel field, such as long or flat products or special steels, or to other fields such as equipment goods. The developing country therefore obtains these supplies, during the stated period, from the industrialized country. This formula has several advantages: in fact it may make it possible to obtain guarantees of stability of supplies and the storage of products, and hence shorter delivery times and possibly an appropriate after-sales service in the developing country. Furthermore it guarantees the work load and, possibly, the maintenance of employment in the industrialized country. It will be the more effective when the products concerned are manufactured by the partners of the iron and steel project. It is however

necessary to avoid the resultant trading involving additional production tonnages of the future plant, since this could encourage the partner in the industrialized country to hold back his total cooperation so as to benefit the commercial outlets of his own products.

II.2.3.3. Conclusions

The three previous types of formulae are not mutually exclusive and may be associated, on the basis of a timetable of cooperation, in such a way as to optimize, in each case, the periods of interest of the partners concerned. In fact, since their impact is different, it is possible to use them according to an appropriate timetable.

II.2.4. POSSIBLE CONFLICTS AND THEIR RESOLUTION

The progress of such a development contract should be straightforward because of the precautions taken when drawing it up, and as a result of the system of counterparts. In reality this will not always be the case, and conflicts may arise. As a general rule the conflicts relate to matters of responsibility which have been poorly defined, the consequences of a failure of one of the partners, unforeseen financial factors, site work, the quality of the equipment or the design, the quality of the men, the causes of delay in achieving objectives, etc. These conflicts could be solved in a spirit of cooperation, by reference to the contractual clauses or, finally, by recourse to arbitration. The whole construction of new industrial agreements is based on the existence of a cooperative relationship between the governments concerned, so allowing their respective control, knowing that the mineral, commercial or financial counterparts will exert a favourable pressure when resolving conflicts. In fact in the absence of a major conflict between the governments the procedure which has been implemented should lead the industrialized country to be the true leader amongst his national partners. Normally, therefore, control should be exercised in an internal manner by arbitration, having as its principal virtue the avoiding of direct conflict with the operators in the developing country.

III GENERAL CONCLUSIONS

In the light of the findings of this study it is possible to define a development contract valid for all the industrial sectors:

"A sectoral, multiform and long duration contract between two partners of different industrial level, based on a balanced exchange of the following type: a quantum of development against strategic resources. Arising systematically from the sectoral analysis of potentialities and complementarities it assumes the collaboration of all the partners concerned under the respective leadership of their governments. The overall equilibrium of the contract therefore lies in the acceptance, by the parties concerned, of drawing up a long-term programmed list of development objectives, on which are to be structured the legal, technological, financial and commercial architecture of the contract. As a counterpart of this cooperation, and of more detailed prices, the less industrially favoured partner is assured of consequent compensation from the other partner."

In conclusion, therefore, the method, applied to the iron and steel sector, has made it possible to identify the possible subjects for development contracts in the sector. Its prospects for further improvement remain essentially linked to its utilization by the countries of the North and of the South.

A N N E X

HYPOTHESES

Let i be the unit investment cost per tonne of steel in the industrialized countries; the minimum unit cost in the developing country is then 2.3i. Assuming that an average iron and steel plant has a capacity of 5 million tonnes and 1 million tonnes respectively in these countries we have :

Cost in the industrialized country $I_{ic} = 5 \times 10^6 i$

Cost in the developing country $I_{dc} = 2.3 \times 10^6 i$

Let us also assume that the rates of achieving full production are as follows :

Year	1	2	3	4	5
Plant in an industrialized country : % of maximum capacity	50	100	100	100	100
Plant in a developing country : % of maximum capacity	20	40	60	80	100

For simplicity let us assume that the credit terms for both plants are based on the same conditions :

- rate of interest 8% per year
- period of 7 years after construction
- reimbursement of principal in 7 equal annual installments
- credit sum equal to total investment.

Assuming that the cost prices per tonne of rolled steel are respectively \$360 and \$590 [1] in the industrialized country and the developing country, and that commercial transfers are effected at this cost price, we then have the following relationship between the two turnovers T_{ic} and T_{dc} :

$$T_{dc} = \frac{590}{360} \times \frac{1}{5} T_{ic} = 0.327\ T_{ic}$$

(1) Figures taken from our previous study for UNIDO, April 1980.

If we consider that the amortization period for accounting and taxation purposes is 10 years we then have :

Amortization in industrialized country = 10% I_{ic}

Amortization in developing country = 10% I_{dc}

From the respective structures of the cost prices[1] we can therefore write :

(Amortization + annual financial charges)$_{ic}$ = 40% T_{ic}

(Amortization + annual financial charges)$_{dc}$ = 55% T_{dc}

(Total financial charges)$_{ic}$ = 32% I_{ic}

(Total financial charges)$_{dc}$ = 32% I_{dc}

Assuming that the financial charges are imputed to the cost price over a period of 10 years we then have :

(Annual financial charges)$_{ic}$ = 3.2% I_{ic}

(Annual financial charges)$_{dc}$ = 3.2% I_{dc}

whence :

13% I_{ic} = 40% T_{ic}

and 13% I_{dc} = 55% I_{dc}

or $T_{ic} = 0.33\ I_{ic}$

and $T_{dc} = 0.23\ I_{dc} = 0.108\ I_{ic}$

Cash flow calculations

Let S_n be the cash flow for the year n, R_n the results for the financial year n, R_{an} the results for the financial year n before amortization, E_n the reimbursement payment of the principal in year n, F_n the financial costs on the loan in year n, D_n the financial charges for cash flow cover in the year n calculated at a rate of 10% on the cash flow S_{n-1}, and B_n the profits for year n.

We can then consider the following situation for the developing country :

- reference situation;
- accelerated rate of achieving full production;
- reduced investment cost but scale effects continuing;
- reduced investment cost and accelerated full production;
- situation in the industrialized country.

(1) Figures taken from our previous study for UNIDO, April 1980.

C

We have the fundamental relationship :

$$S_n = S_{n-i} + R_{an} - E_n - B_n \quad (1)$$

with $E_n = \frac{2.3}{7} \times 10^6 i$ for $0 \leq n \leq 7$; if $n > 7$ $E_n = 0$ (2)

$F = 2.3 \times 10^6 i \ (1 - \frac{n}{7}) \ 8\%$ for $0 \leq n < 7$; if $n \geq 7$ $F_n = 0$ (3)

(F_n is included in C_n, the charges for the financial year)

$$D_n = -S_{n-1} \times 10\% \quad (4)$$

$R_{an} = R_{en} + A$ for $0 < n \leq 10$; if $n > 10$ $R_{an} = R_{en}$ (5)

$A = \frac{2.3 \times 10^6 i}{10}$ for $0 < n \leq 10$; if $n > 10$ $A = 0$ (6)

$B = \frac{1}{2} R_{en}$ if $R_{en} > 0$; if $R_{en} < 0$ $B_n = 0$ (7)

We will assume in the following that $I_{dc} = I = 2.3 \times 10^6 i$

R_{en} is the operating result for the financial year n. If we call the turnover corresponding to the maximum utilization of the production capacity $T_{dc,100}$ then we have :

$T_{dc,n} = 0.2\ n \times T_{dc,100}$ according to the rate of achieving full production: this relationship is valid for $0 < n \leq 5$: after that $T_{dc,n} = T_{dc,100}$

If we assume that the fixed costs account for 70% of the cost price and do not include the cost of financial cover we can write :

Cost for year n = $C_n = (0.70 + 0.06n)\ T_{dc,100} - S_{n-1} \times 10\%$ for $0 \leq n \leq 5$.

Since the financial charges for the loan, F_n, are already included in C_n they do not have to be accounted for again.

When $5 < n < 10$ $C_n = T_{dc,100} - S_{n-1} \times 10\%$,

but when $n > 10$ the amortization and interest charges no longer have to be imputed, and therefore :

$$C_n = 0.45\ T_{dc,100} + S_{n-1} \times 10\%$$

Taking into account the fact that $T_{dc,100} = 0.23\ I$

$R_{en} = (0.032n - 0.16)\ I + S_{n-1} \times 10\%$ for $0 < n \leq 5$:

when $5 < n < 10$ $R_{en} = + S_{n-1} \times 10\%$

when $10 < n$ $R_{en} = 0.126\ I + S_{n-1} \times 10\%$

Consequently we have :

$$R_{an} = (0.032n - 0.06)\ I + S_{n-1} \times 10\% \quad \text{for } 0 < n \leq 5$$

when $5 < n < 10$ $\quad R_{an} = 0.1\ I + S_{n-1} \times 10\%$

when $10 < n$ $\quad R_{an} = 0.126\ I + S_{n-1} \times 10\%$

Reference situation :

$0 < n \leq 5 \quad S_n = 1.1\ S_{n-1} + (0.032n - 0.203)\ I$

$5 < n \leq 7 \quad S_n = 1.1\ S_{n-1} - 0.043\ I$

$7 < n \leq 10 \quad S_n = 1.1\ S_{n-1} + 0.10\ I - B_n$

$10 < n \leq 20 \quad S_n = 1.1\ S_{n-1} + 0.26\ I - B_n$

Variant : accelerated rate of achieving full production :

Assuming full production after 2 years we have :

$0 < n \leq 2 \quad R_{en} = 0.5n.T_{dc,100} - (0.70 + 0.15n)\ T_{dc,100} + S_{n-1} \times 10\%$

or : $\quad R_{en} = (0.35n - 0.70)\ T_{dc,100} + S_{n-1} \times 10\%$

$\quad R_{en} = (0.08n - 0.60)\ I + S_{n-1} \times 10\%$

if $2 < n \leq 10$ then $R_{en} = +S_{n-1} \times 10\%$

if $10 < n < 20$ then $R_{en} = 0.26\ I + S_{n-1} \times 10\%$

whence :

$0 < n \leq 2 \quad S_n = 1.1\ S_{n-1} + (0.08n - 0.203)\ I$

$2 < n \leq 7 \quad S_n = 1.1\ S_{n-1} - 0.043\ I$

$7 < n \leq 10 \quad S_n = 1.1\ S_{n-1} + 0.1\ I - B_n$

$10 < n \leq 20 \quad S_n = 1.1\ S_{n-1} + 0.126\ I - B_n$

Variant : reduced investment cost and reduced size :

Let us assume that only the size effect distinguishes the investment cost, and let us retain the reference capacities.

Then we have, according to the correlation between unit cost and capacity, $i_{dc} = 1.30\ i$; then :

$$I_{ic} = 5 \times 10^6 i$$

and $\quad I_{dc} = 1.3 \times 10^6 i$

but the relationship $T_{ic} = 0.33\ I_{ic}$ still remains valid.

Furthermore the cost price in the developing country has fallen because of the reduction in the investment costs from \$590 to \$440 per tonne of steel; therefore :

$$T_{dc} = \frac{440}{360} \times \frac{1}{5} T_{ic} = 0.244\ T_{ic}$$

and $T_{dc} = 0.31\ I_{dc}$ since the amortization and financial charges represent only 42% of T_{dc}.

The basic relationships therefore become :

$$E_n = \frac{1.3 \times 10^6 i}{7} \quad \text{for } 0 < n \leq 7; \quad \text{if } n > 7 \quad E_n = 0$$

$$A_n = \frac{1.3 \times 10^6 i}{10} \quad \text{for } 0 < n \leq 10; \quad \text{if } n > 10 \quad A_n = 0$$

$R_{en} = T_{dc,n} - C_n = 0.2\ n.T_{dc,100} - (0.65 + 0.07n)\ T_{dc,100} + S_{n-1} \times 10\%$

for $0 < n \leq 5$, since the fixed costs represent only 65% of the cost price and $T_{dc,100} = 0.31 \times 1.3 \times 10^6 i$;

for $5 < n \leq 10$ $R_{en} = S_{n-1} \times 10\%$;

for $10 < n \leq 20$ the amortization and interest charges are nil, and :

$$R_{en} = 0.52\ T_{dc,100} + S_{n-1} \times 10\%$$

from which, by taking $1.3 \times 10^6 i$ as equal to $0.56\ i$, we obtain :

$0 < n \leq 5$ $S_n = 1.1\ S_{n-1} + (0.023n - 0.139)\ I$

$5 < n \leq 7$ $S_n = 1.1\ S_{n-1} - 0.024\ I$

$7 < n \leq 10$ $S_n = 1.1\ S_{n-1} + 0.056\ I - B_n$

$10 < n \leq 20$ $S_n = 1.1\ S_{n-1} + 0.090\ I - B_n$

<u>Variant : reduced investment cost and accelerated rate of achieving full production</u> :

The only change is that, for $0 < n \leq 2$:

$$R_{en} = 0.5\ n.T_{dc,100} - (0.65 + 0.175n)\ T_{dc,100} + S_{n-1} \times 10\%$$

We therefore have :

$0 < n \leq 2$ $S_n = 1.1\ S_{n-1} + (0.057n - 0.066)\ I$

$2 < n \leq 7$ $S_n = 1.1\ S_{n-1} - 0.024\ I$

$7 < n \leq 10$ $S_n = 1.1\ S_{n-1} + 0.056\ I - B_n$

$10 < n \leq 20$ $S_n = 1.1\ S_{n-1} + 0.09\ I - B_n$

Variant : situation in the industrialized country :

We are assuming that fixed costs account for 70% of the cost price, therefore :

$$R_{en} = T_{ic,n} - C_n = 0.5\ n.T_{ic,100} - (0.70 + 0.15n) + S_{n-1} \times 10\%$$

$$= (0.35n - 0.70)\ T_{ic,100} + S_{n-1} \times 10\%$$

or $T_{ic,100} = 0.33 \times 5x10^6 i = 0.717\ I$ when $0 < n \leq 2$

whence $R_{en} = (0.25n - 0.5)\ I + S_{n-1} \times 10\%$

$$A = \frac{5x10^6 i}{10} = 0.217\ I \qquad E_n = 0.31\ I$$

$0 < n \leq 2$ $S_n = 1.1\ S_{n-1} + (0.25n - 0.593)\ I$

$2 < n \leq 7$ $S_n = 1.1\ S_{n-1} - 0.093\ I$

$7 < n \leq 10$ $S_n = 1.1\ S_{n-1} + 0.217\ I - B_n$

$10 < n \leq 10$ $S_n = 1.1\ S_{n-1} + 0.287\ I - B_n$

All the calculations have been expressed as a function of the investment cost of the reference plant in the developing country so as to allow comparisons.