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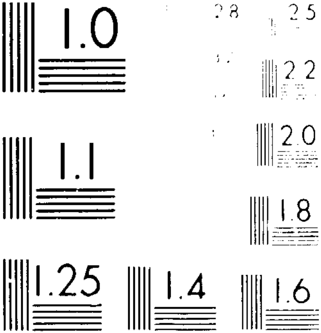
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UNITED NATIONS INDUSTRIAL
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1990 SCENARIOS FOR THE IRON AND STEEL INDUSTRY

- PART ONE -

"THE DOSSIERS"*

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* This study has been translated from an unedited original.

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As far as the interpretation of this information and the weight given to the scenarios are concerned these remain the entire responsibility of the Sectoral Studies Section of UNIDO.

CONTENTS

INTRODUCTION

The project "1990 Scenarios for the Iron and Steel Industry" is to be discussed by the Working Group formed for this purpose following the Second World Consultation on the Iron and Steel Industry (New Delhi, 15 - 19 January, 1979).

In accordance with its recommendations reports were prepared summarizing the information and problems in respect of the following questions:

1. Iron and steel projects in the developing countries in 1990,
2. Raw materials and energy,
3. Markets, product ranges and scale economies,
4. Technology and research,
5. Labour and the development of human resources,
6. The execution of projects and commissioning of new plants. (The dossier also contains information relating to the infrastructure and transportation.),
7. Costs and financing.

Each of the dossiers contains a summary of the problems encountered by the developing countries when creating their iron and steel industry, the objectives of subsequent negotiations among the international community, and hypotheses concerning the evolution of those factors which will be used to constitute a survey of the industry.

The above mentioned subjects are covered by the second part of this document.

In the first instance, an attempt was made to utilize existing global surveys (using the OECD "Interfuturs", R.I.O. and United Nations reports, the IIASA energy surveys, etc.). Macro-economic and social-political hypotheses were used as a framework for surveys specific to the iron and steel industry.

Then the hypotheses on the evolution of variables specific to the steel industry were combined by linking their compatibility and coherence with hypotheses relating to external variables.

The result of these combinations defines the outline of the trend, contrasted and normative scenarios, each having their own characteristics, degree of probability, levels of co-operation and conflict and objectives for negotiation, and it will be the responsibility of the international community to select the reference scenario or scenarios.

* * *

D O S S I E R   I

1990 PROJECTS IN THE DEVELOPING COUNTRIES

DOSSIER - PROJECTS

A - INTRODUCTION

1. The decision was taken, at the end of the second consultation meeting held in New Delhi at the beginning of 1979, to proceed with the construction of alternative scenarios on the growth of the world iron and steel industry up to 1990.

2. The working group which was established for this purpose felt, during the meeting in Algiers in December 1979, that the construction of a 1985 picture of the world iron and steel industry should constitute the first stage of this work.

3. A "Picture for 1985 of the World Iron and Steel Industry"[1] was proposed and discussed by the working group during its meeting in September 1980. The object of this note was "less to put forward a group of quantitative data of high accuracy for 1985 than to identify the most important problems posed by the development of the iron and steel industry, and to highlight the principal components of this industry, with special reference to those developing countries which were preoccupied with achieving the Lima objectives ....".

In particular the 1985 picture shows that the steel deficit in the developing countries, instead of being absorbed, would continue to worsen until it reached a level of about 70 million tonnes.

4. The work which is presented here uses the study on the 1985 picture as the starting point; it extends it up to 1990 on the basis of the collection and analysis of details on all the iron and steel projects under construction or which are being studied. Certainly beyond 1985 there is less information available, and it is of a more random nature, whilst the "fluidity" of the projects is such that the situation, as observed at any given moment, may change, sometimes to a considerable extent, within the space of a few weeks.

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(1) UNIDO/ICIS. 161/Rev. 1 - 16 July 1980 - Original: French.

This does not in any way diminish the value of the undertaking, inasfar as the projects reflect, in all cases, the intentions and strategies of the actors concerned, whilst the evolution of the projects illustrates the problems and difficulties which they encounter.

B. PROJECTS AND PRODUCTION CAPACITIES FOR 1990

1. The list of the projects identified in the annex to the study of the 1985 picture has been supplemented on the basis of the available information(1).

Projects for extensions or new projects have been classified under three headings:

- I General project concept and pre-feasibility study
- II Projects under study and negotiation
- III Projects under construction or for immediate construction (contract signed and financial backing obtained).

2. One hundred and twenty-five projects were identified, the total capacity of these being about 116,000,000 tonnes of steel equivalent: of these about 58,000,000 tonnes were in category I and II whilst 58,000,000 tonnes were in category III.

3. Of the 125 projects:

- 43 are projects for mini-iron and steel works (less than 200,000 tonnes), corresponding to an overall capacity of about 4,000,000 tonnes(2);
- 30 are projects for units of 200,000 to 500,000 tonnes capacity, corresponding to a total capacity of about 11,000,000 tonnes;
- 20 are projects for units of 500,000 to 1,000,000 tonnes capacity, corresponding to a total capacity of about 16,000,000 tonnes;
- and 32 are projects for units with a capacity exceeding 1,000,000 tonnes, corresponding to a total capacity of about 85,000,000 tonnes (or about 70% of the total capacity of the projects).

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(1) 1985 Picture

(2) Account should also be taken of four groups of mini-iron and steel works identified in the Republic of Korea, in another Asiatic country and in Brazil, and three projects without any indication of capacity.

4. Geographically speaking these projects can be divided up as follows:

- In Asia 33 projects, including:
  - 7 mini-works
  - 9 projects of 200,000 to 500,000 tonnes,
  - 6 projects of 500,000 to 1,000,000 tonnes,
  - 11 projects of more than 1,000,000 tonnes.

  giving a total capacity of about 42,000,000 tonnes.

- In Africa south of the Sahara 21 projects, including:
  - 15 mini-works
  - 3 projects of 200,000 to 500,000 tonnes,
  - 1 project of 500,000 to 1,000,000 tonnes,
  - 2 projects of more than 1,000,000 tonnes,

  giving a total capacity of 9,000,000 tonnes.

- In North Africa and the Middle East: 28 projects, including:
  - 12 mini-works,
  - 5 projects of 200,000 to 500,000 tonnes,
  - 5 projects of 500,000 to 1,000,000 tonnes,
  - 6 projects of more than 1,000,000 tonnes,

  giving a total capacity of about 19,000,000 tonnes.

- In Latin America: 43 projects, including:
  - 9 mini-works
  - 13 projects of 200,000 to 500,000 tonnes,
  - 8 projects of 500,000 to 1,000,000 tonnes,
  - 13 projects of more than 1,000,000 tonnes,

  giving a total capacity of about 46,000,000 tonnes.

The total announced or estimated cost of all these projects is about $160,000 millions, divided up as follows:

- $4,135 million for the mini-plants(3),
- $11,255 million for the projects of 200,000 to 500,000 tonnes,
- $20,840 million for the projects of 500,000 to 1,000,000 tonnes,
- $123,175 million for the units of more than 1,000,000 tonnes (or 77% of the total sum).

These 125 projects are located in 55 countries, of which:

- 12 are in Asia,
- 14 are in Africa south of the Sahara,
- 16 are in North Africa and the Middle East, and
- 13 are in Latin America.

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(3) To which should be added $2,675 million for the mini-projects in South Korea, the other Asian countries, Mexico and Brazil.

However no project has been identified in 50 developing countries (9 in Asia, 23 in Africa south of the Sahara, 6 in North Africa and the Middle East and 12 in Latin America).

5. It may be stated that, between 1980 and 1990, the following countries should have access to more sophisticated iron and steel production:

- Integrated steel plants (including sponge iron and electric furnace integrated plant)

  Thailand,
  Philippines,
  Pakistan,
  Syria,
  Libya,
  Morocco,
  Nigeria,
  Ecuador,
  Saudi Arabia,
  Oman,
  Abu Dhabi,
  Bangladesh.

- Production of flat products:

  Thailand,
  Philippines,
  Indonesia,
  Pakistan,
  Iran,
  Syria,
  Libya,
  Nigeria.

- Production of high-grade and special steels:

  Pakistan,
  (Iran) ?
  Nigeria,
  (Algeria) ?
  (Colombia) ?
  Other Asian countries

whilst 50 companies will still not have any iron and steel production.

The situation regarding the various projects is summarized as an annex at the end of Dossier I.

C. UNEQUAL GROWTH AND DIFFERENTIATION

6. The projected growth of the iron and steel industry is in the hands of countries:

- which have a medium or large population,
- where the gross fixed capital formation is covered by intermediate or high revenues,
- where the projects generally exceed $300 millions in the case of a non-integrated unit of small size and $5 billion in the case of a medium-sized integrated unit (of 1 million tonnes),
- where the per capita consumption of steel is already average or high,
- and, particularly, where hydrocarbons resources are available.

7. This last characteristic can be seen in particular from an examination of the projects with a unit capacity of 1 million tonnes or above. They are located in 20 countries and represent about 85% of the iron and steel capacity under construction or projected in the developing countries.

Table 1

	1978 Population, millions	1978 GFCF US$b	Revenue US$	1977 steel consump-tion (kg)	Projected production capacity, millions tonnes	Oil-producing country
Nigeria	80	13.5	560	20	7.0	X
Algeria	18	11.0	1,260	110	2.0	X
Libya	2.7	4.5	6,910	250	1.3	X
Egypt	40	4.4	390	25	1.6	X
Iran	35	25.7	2,160	150	6.9	X
Iraq	12	5.0	1,860	60	2.0	X
Saudi Arabia	8	18.9	7,690	300	1.0	X
Syria	85	2.4	930	70	1.2	X
India	650	27.6	180	17	11.2	X
Pakistan	77	3.2	230	10	2.5	
Indonesia	140	9.6	360	10	4.4	X
Philippines	45	6.9	510	35	1.2	
Other Asian countries	17	6.2	1,400	250	9.0	
Republic of Korea	36	13.6	1,160	180	1	
Thailand	40	5.55	490	40	2.3	X
Argentina	25	12.5	1,910	150	4.8	
Brazil	119	43.1	1,570	100	15.0	
Mexico	60	21.1	1,290	110	15.0	X
Venezuela	15	16.0	2,910	220	5.1	X
Cuba	14	8.0		n.a	2.6	
Total				about	100(5)	

It can be seen that, of these 19 countries:

- 13 have more than 20 million inhabitants,
- 15 have an investment capacity (in 1978) of $5 billion or higher(6).

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(5) 100 million tonnes capacity out of a total of approximately 116 million tonnes.

(6) Three others are countries with oil resources (Libya, Egypt and Syria).

- 14 have a per capita revenue of US$500 or higher (12 with more than US$800),
- 12 countries have a per capita steel consumption (1977) of 50 kg or higher,
- 13 are oil-producing countries.

Hence the dynamism of the growth of the iron and steel industry is affected by differences in population, availability of raw materials, financial resources (in conjunction with the production of hydrocarbons) and the degree of advancement of the mastery of industrial systems.

8. These factors explain why there are three privileged zones for the development of the iron and steel industry:

- Latin America, with Brazil, Mexico, Argentina and Venezuela, and hence with three oil-producing countries out of four, the fourth being a major producer of iron ore;
- South and South-East Asia with India, the Republic of Korea and the other Asian countries;
- the oil-producing countries of Africa and the Middle East including Nigeria, Iran, Algeria, Libya, Egypt and the Persian Gulf countries.

9. A double division becomes clear:

- firstly between the industrialized countries engaged in implementing increasingly diversified and sophisticated iron and steel production and the developing countries, where the production is still largely marked by its non-diversified and general product character;
- then between the more dynamic developing countries (the 20 countries listed above) and the developing countries with a low revenue which have no iron and steel production or a very rudimentary production.

It may be asked whether this second differentiation will not become even more marked during the decade, inasfar as several countries in the first group have already entered into the process of diversification and higher quality.

D. THE IMPORTANCE OF THE DIRECT REDUCTION METHOD

10. At the beginning of 1980 several indices suggested that the optimistic forecasts relating to the development of direct reduction processes could be questioned. It seemed in fact that direct reduction had run into:

- technical difficulties in commissioning: the closure of the Brazilian installations at Cosigua, continuing problems with the Yugoslavian plant at Skopje, etc.
- the rapid rise in the price of energy and, in particular, the rapid rise in the price of natural gas, resulting in the closure of the American Oregon Steel plant, the freezing of the British plant at Hunterston, of certain Spanish projects, etc.

11. In fact these hesitations and withdrawals affected the iron and steel industries of the North much more than those of the Third World countries where, on the contrary, there has been a vigorous revival of the direct reduction process in recent months as is shown by the following examples:

- the launching of the improved HYL III process, more economic in energy, adopted since its introduction in Mexico (SICARTSA), in Argentine (the SIDESUR project) and the improved MIDREX processes which were also more economic in energy;
- the increased interest of the major international iron and steel groups in the direct reduction processes: SWINDEL DRESSER, DAVY DRAVO Corp., KAWASAKI HEAVY INDUSTRIES in the case of the HYL process and KORF, VOEST ALPINE, KOBE STEEL and MITSUI in the case of the NIPPON STEEL MILDREX process.

In this context a listing of the direct reduction projects highlights the following factors.

12. Most of the direct reduction projects have been frozen or abandoned in the <u>industrialized countries</u> where only the following projects still remain:

Australia (Hammersley)	1.0m tonnes
Canada (Alberta)	0.6m tonnes
Bulgaria (?) (Burgas)	1.0m tonnes
USSR (Koursk)	?

13. Direct reduction projects are multiplying in the <u>developing countries</u> (projects under construction or new projects).

			capacity in millions tonnes
Argentina	SIDERSUR		0.5
	DALMINE-SIDERCA		0.3
Brazil	SIDERSUL		0.45
	USIBA		0.2
Venezuela	SIDOR		3.5
Mexico	HYLSA, TAMSA, Mexican-Japanese project, SICARTSA, SIDERMEX 2		15.0
Colombia	FERROMINERA		0.1
Peru	CHIMBOTE		0.4
Ecuador			0.4
Trinidad	ISCOTT		0.6
Total for Latin America:		approximately	22.0m tonnes
Kenya			0.3
Nigeria	DELTA STEEL		1.3
Liberia			0.5
Total for Africa south of the Sahara:			2.1m tonnes
Algeria	JIJEL		2.0
Libya	MISURATA		1.3
Egypt	DEKKHEILA, SADATVILLE		1.5
Iraq	KHOR EL ZUBER		2.0
Iran	AHWAZ, ISPAHAN		5.5
Saudi Arabia	JUBAIL		0.8
	JEDDAH extension		0.1
Abu Dhabi			0.4
Qatar	QATAR STEEL		0.4
Oman			0.125
Total for Middle East and North Africa:		approximately	14.125m tonnes
India	VINAYAJAGAR		1.0
	Two other projects		0.12
			0.4
Bangladesh			0.5
Burma			0.04
Malaysia			1.2
Thailand			2.0
Philippines			1.0
Indonesia			4.3
Pakistan			0.5
Total for Asia:			112m tonnes

14. Forty projects, representing a capacity of about 46.0 million tonnes, are at the present time being started or are the subject of in-depth studies, representing more than 40% of the capacity of the projects being studied or under construction in the developing countries (about 116 million tonnes).

These projects can be divided up in the following manner:

Table 2

	A Number of DR projects	B Capacity of DR projects (millions t)	C Total projected capacities (millions t)	B/C %
Latin America	14	22	45	49
Africa south of the Sahara	3	21	9	23
North Africa and the Middle East	11	14.1	19	74
Asia	12	11.2	42	27
Total	40	49.4	116	42

They thus constitute:

- in Latin America: 49% of the projected capacities
- in Africa south of the Sahara: 23% of the projected capacities
- in the Mediterranean and Middle East: 74% of the projected capacities
- in Asia: 27% of the projected capacities

15. Whilst projects based on direct reduction processes were, until recently, projects of low unit capacity and projects integrated into a production of long products (concrete reinforcing bars), a considerable number of new projects are, on the contrary, characterized by:

- their size, which now exceeds 1.0 million tonnes[7] in Indonesia, Iran, Iraq, Libya, Algeria, Nigeria, India and even more in Venezuela (SIDOR) and Mexico (SICARTSA, HYLSA, SIDERMEX);
- their integration into complexes which produce both long and flat products in the case of the projects in Mexico, Venezuela (SIDOR), Nigeria, Libya or Iran.

16. Numerous direct reduction processes are now available, using either natural gas or a solid reducing agent (non-coking coal). In fact at the present time there is a preponderance of reduction processes using natural gas, in particular the MIDREX processes (which has been the subject of successive improvements) and the HYL process (the dynamism of which has now been renewed by the launching of the new HYL III variant) and these at the present time represent more than 90% of the direct reduction projects in the developing countries.

17. It can be seen from this fact that the advance of the direct reduction processes is linked to the availability of hydrocarbons and, in particular, the toxic gases which up to now have remained unused: 90% of the direct reduction projects are in fact located in oil or gas producing countries.

- 100% of the projects in the oil-producing countries of Africa and the Middle East,
- 90% of the projects in the oil-producing countries of Latin America (Venezuela, Mexico, Argentina, Ecuador, Colombia, etc.),
- 66% of the projects in the oil-producing countries of Asia (Indonesia, Malaysia, etc.)

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(7) 12 direct reduction projects are integrated in complexes of which the capacity is 1.0 million tonnes or higher.

18. It will be noted that the renewal of interest in oil fields which are deeper and hence more expensive to work will result in the probable discovery of oil resources in many other developing countries, as is the case today in Africa, on the Ivory Coast, in Cameroon, etc.

This opens up new possibilities for the utilization of direct reduction processes in new zones which will in this way have the necessary bases to acquire an iron and steel industry.

E. THE DESTINATION OF PRODUCTION AND THE LOCATION OF PROJECTS

19. A total of 125 projects[8] have been definitively listed. Less than 10% of these are explicitly directed towards exporting: these are in particular projects for the production of iron sponge by direct reduction processes either totally, as is the case with the Mexican-Japanese project intended to supply sponge iron for the Japanese iron and steel industry, or partially, as is the case with the projects in Malaysia (exporting to the Republic of Korea or Japan), in Indonesia (Krakatau Steel), in Thailand, Qatar, Abu Dhabi and Trinidad (Iscott) and four projects for integrated iron and steel plants as in the case of Tubarao in Brazil, in Vizakapatnam and Paradip in India which will have to export part of their production[9].

It is obvious that many other projects will contribute towards exports intended to compensate for imports (of equipment, ore, coking coal, etc.) but without being projects specifically directed towards exporting: this is the case, for example, with the iron and steel industries of Brazil, Argentina, Korea, etc.

Location

20. Of the 125 projects identified, and with the proviso of some uncertainty as to the exact location of some of these, about 80 are coastal projects and 50 are inland projects.

21. It will be noted that many inland projects are located in three countries:

- Brazil: extensions at Cosipa, Usiminas, Belgomineira, Mannesmann and Acesita and the Acominas project, etc.,
- Mexico: extensions at Ahmsa, FMSA and HYLSA,
- India: extensions at Bhilai, Bokaro, and Tisco and the direct reduction projects.

(8) To these should be added three projects which have been identified without any indication of capacity

(9) The exports forecast from Tubarao seem to be running into difficulties.

22. The installed capacity of the projects belonging to these three countries account for about 90% of the capacity of all the "inland" projects.

23. Most of the countries creating or developing their iron and steel industries have coastal projects. This location of the projects is apparently in contradiction with the priority destination - the domestic market - of practically all the new projects. Examination of the patterns of trade necessitated, in particular, by supplies to the new iron and steel industries, make it possible to provide an explanation of such location.

It can be seen from an examination of Table 5 (see the following pages) that:

- with the exception of India most of the largest iron and steel industries in the Third World import coking coal: Mexico, Brazil, Argentina, the Republic of Korea, other Asian countries, Algeria, Egypt, Nigeria, Iran, etc.
- the establishment of direct reduction installations involves the development of major commercial trading, whether it involves the exporting of iron sponge or mainly the importing of high quality iron ore as is forecast for the following countries: Trinidad, Mexico, Argentina, Algeria, Libya, Egypt, Saudi Arabia, Qatar, Abu Dhabi, Oman, Iraq, Iran, Nigeria, Indonesia, Thailand, Malaysia and Bangladesh[10].

In most of these cases the new iron and steel industries will have recourse to importing, either coking coal, high grade iron ore or scrap iron (or billets), even if local resources can cover part or all the necessary supplies as is the case with the other Asian countries and the Republic of Korea.

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(10) For example the importing of ore from Guinea into Algeria, of ore from Brazil or Liberia into Nigeria, of Australian or Indian ore into Malaysia, of Indian ore into Abu Dhabi and Oman, etc.

The obligation to have recourse to technical assistance from the major international manufacturers again indicates the international character of the growth of national iron and steel industries in the developing countries. The development of the direct reduction route is significant of this process, inasfar as two major processes are being promoted by a small number of major international constructors who share a rapidly expanding market, almost exclusively located in the developing countries.

This means, for the iron and steel industries in the developing countries (except perhaps in Colombia and Venezuela), their dependency on and inclusion into an international trading system for raw materials, but also the possibilities of interdependence and more active collaboration between the developing countries themselves.

Table 3 (*)

Country	Site coastal C inland I not determined ND	Exporting part of the production	Local availabilities		Imports required		
			Iron ore	Energy	Iron ore	Scrap and billets	Coking coal
Senegal	C		X			X	
Liberia	2 C	X	X				
Ivory Coast	C		X			X	
Gabon	C		X	Oil			
Ghana	C			Oil		X	
Togo	C					X	
Zaire	I			Hydroelectric power		X	
Angola	C					X	
Zimbabwe	I		X	Coal			
Zambia	I					X	
Mozambique	C					X	
Nigeria:							
- Delta Steel	C			Natural gas	X		
- Ajaskuta	ND						X
- Birla	ND						
- Oshoro	ND						
Tanzania	2 C					X	
Kenya	C			Charcoal			
Central African Rep.	I					X	
Cameroon	C			Petroleum gas		X	
Syria	I		X				X
Jordan	I					X	
Iraq	C (river)			Natural gas	X		
Qatar	C	X		Natural gas	X		
U.A.E.	C	X		Natural gas	X		
Oman	C			Natural gas	X		
Saudi Arabia	C			Natural gas	X		
(continued over)							

(*) Not all the projects are shown on these tables, since certain groupings have been carried out within the countries.

Table 3 (continued)

Country	Site: coastal C, inland I, not determined ND	Exporting part of the production	Local availabilities: Iron ore	Local availabilities: Energy	Imports required: Iron ore	Imports required: Scrap and billets	Imports required: Coking coal
Egypt:							
- Dekheila	C			Natural gas	X		
- Sadatville	I						
Libya	C			Natural gas	X		
Tunisia	C		X	Natural gas	X	X	
Algeria:							
- El Hadjar	C		X				X
- Jijel	C			Natural gas	X		
Morocco	C					X	(X)
Iran:							
- Ispahan	I		X		X		X
- Ahwaz	I			Natural gas	X		
- Ispahan	I				X		
Pakistan	C			Natural gas	X		X
India			X	Coking coal			
- Inland	I						
- Coastal	C	X					(X)
Bangladesh	C			Natural gas	X		
Burma	C			Natural gas	X		
Malaysia	C		X	Charcoal	X	X	
	C	X		Natural gas	(X?)		
Singapore	C					X	
Indonesia	C	X		Natural gas	X		
Thailand	C	X		Natural gas	X		
Philippines	C		X	Charcoal (?)			X
Other Asian countries	C				X	X	X

(continued over)

Table 3 (continued)

Country	Site coastal C inland I not determined ND	Exporting part of the production	Local availabilities		Imports required		
			Iron ore	Energy	Iron ore	Scrap and billets	Coking coal
Republic of Korea:							
- Posco	C				X	X	X
- Asan	C				X	X	X
Trinidad	C	X		Natural gas	X		
Dominican Republic	C					X	
Honduras	I			Charcoal			
Cuba	C				X		X
Paraguay	I					X	
Colombia	I		X	Coking coal			
Peru	C		X	Coking coal			X
Chile	C		X	Coking coal			
Venezuela:							
- Sidor	C	X	X	Natural gas			
- Zulia	I		X	Coking coal			
Mexico :							
- Coastal project	C	X		Natural gas	X		X
- Inland projects	I		X	Natural gas Coking coal	X		X
Brazil:							
- Inland projects	I		X	Charcoal			X
- Coastal projects	C	(X)	X				X

(continued over)

Table 3 (continued)

Country	Site coastal C inland I not determined ND	Exporting part of the production	Local availabilities		Imports required		
			Iron ore	Energy	Iron ore	Scrap and billets	Coking coal
Argentina:							
- Somisa	C		X		X		X
- Sidinsa	C				X		X
- Zapla	C		X	Charcoal			
- Acindar	C			Natural gas	X		
- Dalmine	C			Natural gas	X		
- Sidersur	C			Natural gas	X		

F. THE PREPONDERANT ROLE OF THE STATE

24. The initiation of the role of the State in the promotion of the iron and steel industry has become preponderant in the developing countries, irrespective of their political systems or their economic and social preferences.

At the present time more than 80% of the projects launched in the developing countries result from the initiative of the State or from State ownership (direct or indirect), in general as a majority shareholder(11). Any contradiction of such phenomena with the increasingly international means of financing of iron and steel projects is only apparent, since the intervention of the State only provides a valid guarantee to the international financing organizations or agents(12).

(11) Whereas in 1950 23% of the world iron and steel industry was State property by 1980 this percentage had increased to 53%. (See paper by W. Hogan, Xth Congress of the Brazilian Iron and Steel Industry - Rio de Janeiro - April 1980).

(12) See on this subject Dossier VII - "Costs and financing".

Table 4. The Role of the State and Foreign Intervention

	Project status S = State P = Private	Foreign technical or financial intervention
Latin America		
Argentina		
- SOMISA	S	Japanese credit (intervention by the Japanese Government?) Cooperation with FRG?
- SIDINSA	S	Cooperation agreements with Davy (GB) Nippon Steel (financing?)
- SIDERSUR		HYL III Process (Kawasaki Steel - Japan Marubeni HYLSA - Mexico)
Brazil		
- TUBARAO	S - 51% &	Kawasaki Steel (Japan) 24.5% Finsider (Italy) 24.5%
- BELGOMINEIRA	P	ARBED (Luxembourg)
- MANNESMANN	P	Mannesmann (FRG)
- COSIGUA	P	Shareholding, ATH (FRG) S.F.I.
- ACOMINAS	S	Credit from international banking consortium
- USIMINAS	S	Shareholding in capital by Japanese group
- MENDES JUNIOR	S/P	Acos Villares (Brazilian company)
- C S N	S	(International credits
- COSIPA	S	(World Bank
- ACESITA	S	(Japan

(cont.)

Table 4. (cont.)

	Project status S = State P = Private	Foreign technical or financial intervention
Bolivia		
(MUTUN)	S	Brazilian shareholding in project?
Columbia	P	DASTUR (India) Study
Peru		
- CHIMBOTE	S	DR - German process
- ACEPAR	P	
Chile	S	
Venezuela		
- SIDOR	S	MIDREX process - Korf FRG RFA HYL process - Swindel Dresser USA - HYLSA Mexico International credits
- ZULIA	S (Minority shareholding envisaged for foreign interests)	
Mexico		
- HYLSA - FUNDID.MONTERREY - TAMSA	P	International credits HYL process HYLSA - Swindel Dresser - Kawasaki Steel - Dravo, etc.
- SICARTSA - SIDERMEX II	S	Agreement with DAVY for the 2nd SICARTSA phase International credits and technical agreements
Cuba	S	USSR cooperation
Honduras	S/P	Shareholding project Brazil
Paraguay	S/P	Shareholding, Brazilian groups

(cont.)

Table 4. (contd.)

	Project status S = State P = Private	Foreign technical or financial intervention
Ecuador	S	
Trinidad	S	MIDREX KORF process Japanese shareholding, equipment
Africa, S. of Sahara		
Mauritania	S	Arab capital
Senegal	S	DASTUR (India) project
Liberia	S/P	USA company shareholding project
Kenya	S	
Cameroun	S/P	USA company shareholding project
Zambia	S	Project with Yugoslavia dropped New project
Nigeria		
- AJAOKUTA	S	Cooperation with the USSR and French companies for the construction (International credits)
- DELTA STEEL	S	MIDREX - cooperation with German companies
- SPECIAL STEELS	S/P	Shareholding (40%) BIRLA company (India)
- Small unit	P	Joint-venture project
N. Africa and Middle East		
Morocco	S	Contract with Davy (GB) and British and international credits

(cont.)

Table 4. (cont.)

	Project status S = State P = Private	Foreign technical or financial Intervention
Algeria		
- EL HADJAR	S	Extension - USSR cooperation - Japanese cooperation - European group (with suppliers' and bank credits)
- JIJEL	S	Study by Tractionel (Bel) then agreement with Nippon Steel
Tunisia	S	Study on extension given to Atkins (GB)
Libya	S	DASTUR: engineering services and main consultant (India) - Japanese suppliers, no credit (cash).
Egypt		
- HELOUAN	S	Extension completed with USSR cooperation
- DEKKHEILA	S += 86% shareholding by Japanese group 10% SFI * = 4%	Japanese credits
Iraq	S	Supplier: Creusot Loire (France) HYL process (Mexico and USA)
Iran		
- ISPAHAN	S	Cooperation with USSR
- AHWAZ	S	RD processes - MIDREX - HYL
- BANDAR KHOMEINI	S	Construction entrusted to Finsider (Italy)
Saudi Arabia	S + shareholding FRG group	MIDREX - KORF (FRG) 80% SABIC 20% KORF/DEG

(cont.)

* SFI = Société Financière Internationale

Table 4. (cont.)

	Project status S = State P = Private	Foreign technical or financial intervention
Qatar	S + Kobe Steel shareholding	Kobe Steel and Japanese interests 30%
Abu Dhabi	S	Indian study (MECON)
Oman	S	DASTUR (India) study
Asia		
Pakistan		
- PIPRI	S	Cooperation with USSR
India		
- BOKARO Extension	S	Cooperation with USSR
- VIZAKAPATNAM	S	Cooperation with USSR (discussion on partial buy-back)
- PARADIP	S	Probably entrusted to consortium headed by DAVY (GB) with buy-back agreement
- MANGALORE	S	Western Europeans and Romanians in the wings
- VIJAYANAGAR	S	ELRED process (Sweden) (??) now withdrawn
Malaysia	S + P national and foreign	With DAEWOO (Rep. Korea) With Nippon Steel (Japan) With Klockner (FRG)
Indonesia	S (and P)	HYL process (Mexico and USA) German cooperation Japanese cooperation
Thailand	S (and P)	Studies carried out by Japan and Austria (Austro Plan)
Philippines	S (and P)	Kawasaki Steel studies Special steels with an American company
	S	New Mindanao project

(cont.)

Table 4. (cont.)

	Project status S = State P = Private	Foreign technical or financial intervention
Rep. of Korea	S	Japanese and European equipment (France, Austria, FRG)
Other Asiatic countries	S/P	Japanese and European equipment

45. Table 12 shows that:

- the State intervenes in all but 7 of the 69 cases under consideration;
- nearly all the projects call for international co-operation, generally from the industrialized countries and in some cases from the countries of the South.

CONCLUSION

Nearly 130 projects, representing a capacity of more than 100 million tonnes: this is the significant fact in the growth of the iron and steel industries in the developing countries. Numerous countries will enter during the eighties into the mastery of integrated iron and steel production; others will pass from the production of long products to the production of flat products, others again will acquire the mastery of the more or less diversified production of special and high grade steels.

Part of these projects are the subject of firm agreements; certain of them are already being built. On the other hand some projects are still in various stages of progress, from imminent agreement to the first pre-feasibility study and the first concept of the project. Part of these projects are therefore affected by uncertainty: their realization will depend on various conditions which it is the precise intention of the scenarios to list. It is certain that the growth of the demand will constitute an important factor which will operate either to accelerate or to hold back the realization of the projects.

The dynamism reflected by the capacity of the projects in the developing countries is thus confirmed in a fairly surprising manner in a world context which is depressed by the crisis and where most of the advanced iron and steel industries are concerned with fewer new projects than with restructuring and sometimes in drastic reductions in activity.

A new equilibrium must therefore be sought:

- on the basis of the replies given to the questions posed on the succession of the entries of the new arrivals into the iron and steel world, on the ranges of products involved, etc.;

- on the basis also of negotiations on the best possible adjustment regarding not only interference and competition but also of complementarities.

Care must be taken not to forget that the realization of the many iron and steel projects listed here will in fact only make a modest contribution to the essential catching up within the framework of the objectives defined by the Lima Conference whilst, on the other hand, dozens of countries, in particular in Africa and Asia, still possess neither an iron and steel industry nor the smallest project in this field.

ANNEX
to Dossier I

SUMMARY OF THE PROJECTS

Annex I/1

Percentage distribution of projects by capacity groups

Distribution des projets par groupes de capacité (pourcentage)

Capacity Capacité (mill t)	Latin America Amérique Latine		Africa South of the Sahara Afrique au Sud du Sahara		North Africa and the Middle East Afrique du Nord et Moyen-Orient		Asia Asie		Total developing countries Total pays en voie de développement	
	Total capacity Capacité totale (million t)	Percentage Pourcentage	Total capacity Capacité totale (million t)	Percentage Pourcentage	Total capacity Capacité totale (million t)	Percentage Pourcentage	Total capacity Capacité totale (million t)	Percentage Pourcentage	Total capacity Capacité totale (million t)	Percentage Pourcentage
0-0.050 0.050 - 0.100 0.100 - 0.200	4.300 a/	9.3	1.025	11.3	1.077	5.6	2.780	6.7	9.182	7.9
0.200 - 0.500	5.225	11.4	1.150	12.7	1.665	8.6	2.455	5.9	10.495	9.0
0.500 - 1.000	4.930	10.7	0.600	6.6	4.415	22.8	5.200	12.5	15.145	13.1
> 1.000	31.510	68.6	6.300	69.4	12.200	63.0	31.175	74.9	81.185	70.0
Total	45.965	100.0	9.075	100.0	19.357	100.0	41.610	100.0	116.007	100.0

a/ Capacity figures for the group 0-0.200 (mini-plants) include mini-plant projects in the Republic of Korea, Mexico, Brazil and in another country of Asia.
Marge de capacité pour les groupes 0-0.200 (mini-usines) y compris des projets de mini-usines en la République de Corée, au Mexique, au Brésil et dans un autre pays de l'Asie.

Annex I/2 **Developing countries: Stages of development of iron and steel projects up to 1990**

Pays en développement : Etat d'avancement des projets sidérurgiques pour 1990

	Latin America Amérique Latine		Africa South of the Sahara Afrique au Sud du Sahara		North Africa and the Middle East Afrique du Nord et Moyen-Orient		Asia Asie		Total developing countries Total pays en voie de développement	
	Capacity Capacité (million t)	Percentage Pourcentage	Capacity Capacité (million t)	Percentage Pourcentage	Capacity Capacité (million t)	Percentage Pourcentage	Capacity Capacité (million t)	Percentage Pourcentage	Capacity Capacité (million t)	Percentage Pourcentage
Stage III Etat III	22.025	47.9	3.370	37.0	13.975	72.2	18.230	43.5	57.600	49.5
Stages I+II Etats I+II	23.940	52.1	5.705	63.0	5.382	27.8	23.380	56.5	58.407	50.5
Total	45.965	100.0	9.075	100.0	19.357	100.0	41.610	100.0	116.007	100.0

Annex I/3 **Least developed countries with iron and steel projects up to 1990**

Pays les moins privilegiés avec projets de métallurgie jusqu'à 1990

Country Pays	Project description Description du projet	Planned capacity Capacité prévue (million t)	Total costs Coût total (bill US$)	Stage of development Etat de développement
Bangladesh	Extension of Chittagong works Expansion des travaux de Chittagong projet	0.100	0.100	II
	Direct reduction project Projet de réduction directe	0.500	n.a.	I
Central African Republic République Centrale Africaine	Mini-plant project Projet de mini-usine	0.010	0.020	I
United Republic of Tanzania République Unie de Tanzanie	TANGA project (mini-plant project) Integrated UNIDO project Projet de TANGA (projet de mini-usine) Projet intégré de l'ONUDI	0.090 0.300	0.150 0.600	I I
Yemen People's Democratic Republic République Democratique Populaire de Yemen	Project idea (UNIDO) (mini-plant project) Idée de projet (ONUDI) (projet de mini-usine)	0.100	0.200	I
Total		1.100	1.070 a/	

a/ Costs for one project in Bangladesh not included.
Le coût d'un projet au Bangladesh exclus.

Annex I/4 Developing countries: Planned capacity and costs of iron and steel plants up to 1990

Pays en développement : Usines sidérurgiques - Capacités prévues et coûts correspondants pour 1990

Capacity Capacité (mill t)	Latin America Amérique Latine			Africa South of the Sahara Afrique au Sud du Sahara			North Africa and the Middle East Afrique du Nord et Moyen-Orient			Asia Asie			Total developing countries Total pays en voie de développement		
	No of proj. N° de proj.	Total capacity Capacité totale (mill t)	Total costs Coûts (bill US$)	No of proj. N° de proj.	Total capacity Capacité totale (mill t)	Total costs Coûts (bill US$)	No of proj. N° de proj.	Total capacity Capacité totale (mill t)	Total costs Coûts (bill US$)	No of proj. N° de proj.	Total capacity Capacité totale (mill t)	Total costs Coûts (bill US$)	No of proj. N° de proj. a/	Total capacity Capacité totale (mill t)	Total costs Coûts (bill US$)
0-0.050	2	0.100	0.350	10	0.315	0.625	4	0.127	0.175	1	0.040	0.060	17	0.582	1.210
0.050 - 0.100 MINI	4	0.400	0.450	2	0.190	0.250	4	0.345	0.280	2	0.200	0.100	12	1.135	1.080
0.100 - 0.200	3	0.550	0.375	3	0.520	0.530	4	0.605	0.455	4	0.540	0.485	14	2.215	1.845
0.200 - 0.500	13	5.225	6.300	3	1.150	1.550	5	1.665	1.050	9	2.955	2.355	30	10.995	11.255
0.500 - 1.000	8	5.930	8.850	1	0.600	0.600	5	4.415	5.800	6	5.200	5.590	20	16.145	20.840
> 1.000	13	33.760	60.650	2	6.300	11.500	6	12.200	19.500	11	32.675	31.525	32	84.935	123.175
	43	45.965	76.975	21	9.075	15.055	28	19.357	27.260	33	41.610	40.115	125	116.007	159.405 b/

a/ Number of mini-plant projects (=43) excludes mini-plant projects in the Republic of Korea, Mexico, Brasil and another country of Asia.
Nombre de projets dans la mini-sidérurgie (=43), non compris ceux concernant la République de Corée, Mexique, Brésil et un autre pays d'Asie.

b/ For several projects no cost estimates are available.
Pour un certain nombre de projets les information sur les coûts ne sont disponibles.

Annex I/5

Number of mini-plant projects (capacity 0-0.200 million tons)
Nombre de projets de mini-usines (capacité 0-0.200 millions de tonnes)

Latin America Amérique Latine	Africa South of the Sahara Afrique au Sud du Sahara	North Africa & the Middle East Afrique du Nord et Moyen-Orient	Asia Asie	Total
9 + mini-plants in Brazil and Mexico	15	12	7 + mini-plants in the Republic of Korea and another Asian country	43 + mini-plants in Brazil, Mexico, Rep. of Korea and another Asian country
9 + mini-usines au Brésil et au Mexique			7 + mini-usines en la République de Corée et dans un autre pays d'Asie	43 + mini-usines au Brésil, Mexique, Rép. de Corée et dans un autre pays d'Asie

DOSSIER II

RAW MATERIALS AND ENERGY

1. The iron and steel industry is a converter of raw materials and a major consumer of energy: in an integrated plant the production of 1 million tonnes of rolled products results from the conversion of approximately 3 million tonnes of iron ore, coking coal, limestone, refractory products, alloying metals, etc. Thus, raw materials and energy constitute a key factor in the development of the steel industry, and the restrictions which they impose over successive periods must be evaluated.

A. RAW MATERIALS AND ENERGY AVAILABILITY AS A CONSTRAINT

2. Historically the production of iron, cast iron and steel has been linked to the proximity of iron ore and reducing agents; charcoal (forest) then coke (coking coal). Less than thirty years have passed since six Western European States linked iron, coal and steel in the same organization (the ECSC), whilst the typology of developing countries proposed in the first UNIDO study on the world iron and steel industry was based on the existence (or absence) of iron ore and reducing agents (coking coal, forests, hydroelectric power, hydrocarbons, etc.)(1)

3. The widespread redeployment announced in 1974-1975(2) also comes under the same heading, to the extent that projects specified were located in regions rich in:

- Iron ore: Brazil and Australia;
- Hydrocarbons (natural gas): Saudi Arabia, Tunisia, Libya and Trinidad;
- Coking coal: Australia, South Africa, etc.

It appeared to derive from a historical movement. In fact, history shows that, for two centuries, world steel manufacturing has been dominated by iron and coal bearing countries, the leading roles being played in succession as follows:

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(1) World-wide Study of the Iron and Steel Industry : 1975-2000 - UNIDO/ICIS/25, 15 December 1976

(2) Cf. on this subject "The World Iron and Steel Industry" (2nd study) prepared by the ICIS. UNIDO/ICIS/89, 20 November 1978.

by Great Britain, supplying more than 50% of the world production before 1850;

by Western Europe (Great Britain, Belgium, Luxembourg, Germany and France), supplying 68% of the world production in 1870;

by the United States, producing 60% of the steel in 1920 and 63% in 1945;

by the USSR, whose steel production exceeded that of the United States in 1971.

4. The general ebb and flow of the redeployment movement has shown that the existence of natural resources does not necessarily constitute a decisive variable on which to base the vitality of the iron and steel industry.

5. More than fifteen years ago, the appearance of the "waterside" iron and steel industries introduced a separation between iron and steel production on the one hand and coal basins (natural resources) on the other.

6. The emergence of the Japanese iron and steel industry in the last twenty-five years has introduced a new element to this historical sequence. The Japanese iron and steel industry is currently the most modern in the world; between 1956 and 1976 it created a new production capacity of 137 million tonnes of crude steel - four times more than the EEC - and yet the total investment price was lower. More than 99% of Japanese steel is produced using oxygen converters (LD) and electric furnaces; approximately 60% of this steel is continuous cast, and production has been rapidly automated. Today, the whole world tends to refer to Japanese consumption standards (coke, for example) or to Japanese steel industry productivity. Unlike Great Britain, continental Western Europe, the United States and the USSR, the Japanese steel industry does not have its own iron ore or coking coal resources (or at least only to a very small extent), and it is forced to import from Australia, Canada, Brazil, India, etc.

7. The Japanese iron and steel industry is not an exceptional case, since its ideas have been copied in the Republic of Korea

7. The Japanese iron and steel industry is not an exceptional case, since its ideas have been copied in the Republic of Korea and other Asian countries - the Korean and Asiatic iron and steel industries are precisely the two industries where, during the 70's, the highest rates of production (and of consumption) have been recorded:

+ 300% in the Republic of Korea between 1974 and 1979,
+ 400% in the other Asian countries between 1974 and 1979.

8. On the contrary we find that the existence of abundant local resources of iron ore or reducing agents is not sufficient to trigger off a rapid development in the iron and steel industry: Colombia, which possesses the largest coking coal reserves in Latin America, produces less than 500,000 tonnes of steel, whilst in the oil producing countries of Saudi Arabia and Venezuela iron and steel production is developing more slowly than was forecast a few years ago.

9. These examples show that nothing is automatic, that the energy constraint exists but that it can be more easily overcome if one is able to operate on other variables, whether technical mastery and high productivity (energy economies) or reductions in transport costs.

10. The relative reduction in supply costs to the steel industry is the consequence of the reduction in maritime transport costs. As from the end of the fifties the reduction in costs of transoceanic transport resulting from the increasing size of ore-carrying vessels was coupled with the fall in the market price of raw materials, particularly of iron ore. These changes have made it possible to seperate supplies on the one hand from iron and steel production on the other.

"At the beginning of the sixties practically every country with a deep-water port was able to obtain basic raw materials at costs which were competitive with the costs obtaining in the United States or Western Europe, that is to say by the traditional producers of these materials. The most striking example of this development took place in the second half of the fifties in the case of Japan which was able to profit from the fall in the cost of raw materials and where, for this reason, the cost of producing steel fell throughout the whole of the succeeding period[3]. The cost of raw materials per tonne of finished steel has varied, in Japan and in the United States, in the following manner:

Table 1

	Japan[a]	United States[a]	Ratio Japan/United States
1956	13.17	56.17	1.66
1966	51.18	47.28	1.08
1976	112.29	151.10	0.74

Source: Federal Trade Commission - USA
Staff report on the U.S. Steel industry and its international competitiveness. November 1977. Table 3-1.

(a) in US Dollars

11. This development could be radically modified as a result of:

- an increase in the price of energy and a recovery in the price of iron ore;
- an increase in maritime freight rates which would transform the conditions of transport of heavy products.

Such new data could operate in favour of the major producer of raw materials and energy, that is to say:

Australia, Canada, South Africa, the USSR, Poland, Venezuela, Mexico, Brazil, Argentine, Algeria and Saudi Arabia.

(3) Dr. Robert W. Crandall "Analysis of the current crisis in the iron and steel industries of the OECD member countries". Paper to the OECD Symposium, Paris, February 1980, pages 1 and 2.

In this respect certain Australian authorities have forcefully emphasized the value and "need" for such a return(4).

12. However those projects being constructed, or which are envisaged up to 1990 (see Dossier I), do not seem to be influenced by these new factors. They are a continuation of past trends, and are characterized by:

- mainly coastal installations, in particular in Africa, the Middle East and Asia;
- supplies remaining broadly dependent on imports, even if the iron and steel production has an essentially domestic (national) destination;
- imports of coking coal: projects in Brazil, Argentina, Pakistan, Nigeria, Syria, Algeria and Iran;
- imports of high-grade iron ore: projects in Mexico, Nigeria, Algeria, Libya, Egypt, Saudi Arabia, Qatar, Iraq, Oman, etc.;
- imports of scrap: projects for medium-sized or small semi-integrated units in Africa and in East and South-East Asia;
- imports of coking coal and iron ore: projects in Korea and Asia.

13. The realization of an increase in contradiction between the national usage of production and the largely international character of supplies leads to an assumption that the "return" of iron and steel production towards the sources of supply, as recommended by the Australians, for example, will not form a marked characteristic of the eighties.

(4) Statement by Sir C. Court, IISI, 13th Annual Conference, Sydney, October 15-17, 1979. Report of Proceedings, pp. 32-35.

In fact, it must be remembered that increases in transport costs will affect the transportation of finished or semi-finished "piece-goods" products as much as, if not more than, bulk items. In addition, iron and steel production based on obtaining more and more specific qualities (linked with specific markets) will not be at all adaptable to the importation of rolled products and, even less, of semi-finished products with properties which are not under direct control and which are hence uncertain[5].

However, the "return" may well occur during the decade following the year 1990. It is significant that, after several years of silence, the Australian Jumbo project has again been raised in 1980. Its implementation depends on the Japanese companies who are recipients, but who will make no actual undertaking "until the time is ripe"[6]. It seems that the time may well not be ripe before the end of the eighties.

B. <u>RAW MATERIALS</u>

<u>Iron ore constitutes the bulk supply of the iron and steel industry</u>

14. In spite of its bulky nature, international trading in iron ore has not ceased to develop since the first imports of haematites from Algeria and Spain needed when the Bessemer process was introduced into Western Europe.

International trading in iron ore has undergone an increase which is more than proportional to the development of world iron and steel production, due to the cumulative effect of the following:

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(5) This tendency towards quality control throughout the production process forms part of a divided-up world iron and steel production of the "production sharing" type (cf. P. Drucker).

(6) Metal Bulletin, 1 July 1980.

- the development of the Japanese steel industry, which is 100% supplied by imports,
- from the sixties, the accelerated transfer of the European steel industry from locally obtained ores to high grade imported ores (79% of the EEC supply in 1977),(7)
- the lesser movement of the American steel industry towards importing (33% of supplies in 1977, 29.1% in 1979).(8)

15. During the eighties, international trade will again increase as a result of increased participation by the developing countries. The relative forecasts for the period 1980-1990 show, in fact, that world imports of iron ore will increase overall by 36% as a result of trends recorded in the various parts of the world:(9)

Western Europe :	+ 25%
Japan :	+ 26%
North and Latin America :	+ 31%
Asia (except Japan) :	+ 160%
Middle East :	+ 200%
Africa :	30 times more

16. Known and listed deposits of high-grade ores are numerous, in particular in America and Africa. It has sometimes been stated that the slow rate of entry into working has been due to reticence in directing capital towards this type of investment. It must be noted, however, that this reticence is selective, and that it detrimentally affects certain zones in the Third World rather than rich mining provinces in the western world(10). The relatively optimistic forecasts

(7) "Acier Arabe" No. 3, 1980

(8) Ditto, and Revue de Métallurgie, May 1980

(9) Iron ore supply demand 1980-1990. Caemi International B.V. The Hague December 1976. Even if the data does not correspond exactly with existing forecasts, the interest remains insofar as the order of magnitude proposed.

(10) According to the same source, 4 countries (Australia, Brazil, Canada and Sweden) would supply 60% of exported ore and 8 countries (i.e. the above plus USSR, India, Liberia and South Africa) would supply 85%.

made in 1976 estimated that by 1990 there would almost be a balance between the international supply and demand of iron ore (+0.850 million tonnes of iron content in 1980 to -7.350 million tonnes in 1990). The slower increase in demand, which corresponds to existing forecasts, should thus theoretically result in an approximate balance between supply and demand. In fact this slowing down of the demand may result - in the absence of guarantees of sales and the availability of capital - in holding back the opening of several mines. In time this could result in shortfalls together with a loss of profit for the economies affected in this way: most of these, such as the Ivory Coast and Guinea, are in Africa.

17. The development of international trading in iron ore is accompanied by a constant increase in the quality of imported ores. Their average iron content varied from 40% in 1940 to 57% in 1971[11]. The trend towards a demand for high grade ores and a high level of purity should increase during the eighties due to combined pressure from the following:

- the need for maximum economy in materials and energy in respect of the predominant standard process (blast furnace, LD steelworks);
- the need to supply new direct reduction plants with high-grade and pure ores.

18. This could cause an increasing devaluation of local deposits, either because the content or composition of the ore does not meet international standards, or because the capacity is insufficient to interest those with the necessary capital to exploit them. The weight

(11) See J. Astier, C.I.T. No. 10, 1975.

of an "international requirement" thus involves the risk of slowing down the investigation and construction of iron and steel plants adapted to local resources, resulting from a preconceived favourable opinion of plants included in an international supply trade in accordance with the "standards".

19. This highlights those discretionary guiding factors which can be used by the main actors when importing raw materials or developing iron and steel techniques. This is one aspect of the "return" constraint which the iron and steel industry exerts upstream on the mines in accordance with the impulses which it receives from downstream.

20. In this respect, it is significant that the opening of several iron ore mines in Africa or in Latin America comes into competition with European, American and, in particular, Japanese steel producers who are both suppliers of capital and purchasers of ore. Whilst the Wologisi project seems to be slumbering in Liberia, the Brazilian project at Carajas is coming back to life: in each case we find that the same Japanese iron and steel industrialists are involved. Furthermore the rapid implementation of the Guelb project in Mauretania depends on both the sustained interest of the European iron and steel producers and the solidarity of Arab capital. We know that the "Association of iron ore producing countries"(13), which Brazil, Canada, the USSR and many other countries have refused to join, has never been able, like OPEC to impose a market reorganization or to put an end to the deterioration in the international price of iron ore.

21. At the beginning of 1980, the actual increase of 34% in iron ore prices recorded in January of that year was termed an "irresistable increase".(13) In fact, it was a limited adjustment which occurred following a long erosion of ore prices in constant terms. It is estimated that this adjustment should be accelerated in order to achieve a level which will make new mining investments more attractive.

(13) "Usine Nouvelle" No. 6, 7 February 1980

The evolution of iron ore prices has been unfavourable when compared not only with the evolution of oil and coking coal, but also with the average price of steel products[14].

Table 2

	1968	1979
Iron ore	100	189
Average for exported Japanese steel products	100	321

22. The weak negotiating power of iron ore suppliers may also be gauged from the fact that the CIF price of ore does not differ with the source of the ore: where imports to Japan are concerned, this leads to an FOB Chile price which is 20% less than the FOB Australia price. Under these conditions the relative cost of the iron ore required for producing one tonne of steel tends to fall, since it only represents 10% (or less) of the cost of standard steel. The evolution of the steel industry towards high-tensile steels can only accelerate this phenomenon: the cost of iron ore accounts for scarcely 1% of the cost of certain high-grade steels[15]. As a result of this examination, it may be concluded that iron ore - from whichever point of view one looks at it - is very unlikely to be a restraining factor during the eighties.

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(14) Cf. Source "Acier Arabe", No. 3, 1980.
The price of oil was multiplied by 6.5 and the price of coking coal by 5 during the period (ending April 1979). Cf. also Voest Alpine, op. cit. page 72. In Japan the CIF price of iron ore increased on average 89% between 1970 and 1979, whilst during the same period the price of steel products increased by 221%.

(15) Very special steels over US$ 2500 per tonne.

Scrap

23. Scrap constitutes an important raw material for the iron and steel industry, providing approximately 25% of its iron supplies(16).

24. Scrap is used as a raw material, in particular for three types of iron and steel industries:

- steel industries in the original industrial countries where the size of the steel stock ensures an abundant supply: the USA, West Germany and the USSR;
- the more recent and dynamic iron and steel industries having poor iron ore and coking coal supplies: Italy, the Republic of Korea and the other Asiatic countries;
- small iron and steel industries in countries with a low level of industrialization, where the supply is frequently insufficient to meet even limited requirements.

Scrap makes up 56% of the Italian iron and steel industry supplies, and 100% in the case of Uruguay and Angola. It will account for 60% to 70% when Tunisian steel production increases.

25. Scrap is a product with a high energy content, and is a future asset in the original industrialized countries where the steel stock is so extensive that it guarantees a continuously increasing supply(17).

Table 3

	Consumption of scrap in kg per tonne of crude steel	Exports of scrap (thousands tonnes)
Great Britain	550	837
USA	512	5,033
Western Germany	397	1,028
USSR	555	1,890

(16) Paper from W. Philips to the AIME Congress, New Orleans, 1979. With regard to scrap, see also the numerous works from the EEC, Geneva.

(17) Source "Stahl und Eisen" No. 10, 19 March 1980, page 512, quoted by Voest Alpine, op. cit. page 64.

Some go so far as to estimate that the world is on its way, in the very distant future, towards a steel industry founded 80% on the conversion of scrap. Meanwhile, the supply of scrap available in the Federal Republic of Germany from 1990 will very likely cover 50 to 60% of its steel production[18].

26. The price of scrap undergoes extreme fluctuations. In a time of crisis it is at its lowest, but it rises in price sharply when circumstances return to normal:

	US$/t[19]
April 1974	111
Peak 1974	144
October 1977	45
July 1978	70
February-March 1980	130, then 150 (170?)

Whenever prices flare up many projects relating to iron sponge production (as a replacement for scrap) reappear, only to be "frozen" again when prices fall. The prospects for the eighties show that 2 to 3 million tonnes of iron sponge will be required by the Japanese iron and steel industry to supplement its scrap supply; the EUROFER estimate for the same period (1985 to 1990) gives the same order of magnitude. It is also probable that neither the United States nor the USSR will take a decisive interest in this route during the eighties because of the abundant availability of scrap.

(18) 30 to 38% comes from supply of old scrap. Source "Stahl und Eisen" idem, page 513 (Voest Alpine, op. cit. page 55)

(19) See Usine Nouvelle, 13.7.1977, 22.9.1977 and 17.11.1977. Revue de Métallurgie, July 1978, Metal Bulletin 26 February 1980, etc.

27. Developing countries are generally short or very short of scrap; when they are hydrocarbon producers direct reduction processes allow them to substitute iron sponge for scrap. Others have to import the required scrap directly or indirectly in the form of old vessels delivered for scrap to the Republic of Korea, Pakistan and the other Asian countries.

Ferro-alloys

28. The component metals in these alloys represent only a small percentage in steel production.

In 1976 United States steel production was made up as follows[20]:

For 128,000,000 short tons of crude steel:

Manganese	:	900,000 (short tons)
Chromium	:	410,000
Silicon	:	347,000
Aluminium	:	200,000
Nickel	:	19,000
Vanadium	:	6,800
Columbium	:	1,466
Tungsten	:	754
Cobalt	:	314

29. Future requirements for ferro-alloys will be affected by two contradictory trends: economies in costly materials on the one hand and production of steels of ever-increasing quality on the other. The resultant of these trends is probably in favour of the second.

(20) Iron and Steel - Bureau of Mines - July 1978, page 15

30. Until recent times their production was largely in the hands of the more advanced countries. Today numerous developing countries are engaged in their production:

Table 4

Country	Production
Brazil	Fe/Mn (5) [a] Fe/Si (5) Fe/V (2) Fe/W (2) Fe/Cr (1) Fe/Mg (1) Fe/Mo (1) Fe/Ti (2) Fe/Cb (1) Fe/Ni (1)
Mexico	Fe/Mn (2)
Venezuela	Fe/Si Fe/Mn
Argentina	Fe/Si Fe/Mn
Chile	Fe/Mn Fe/Si Fe/Mo
India	Fe/Mn (5) Fe/Si (1) Fe/Cr (1) Fe/Mo (1) Fe/Ti (1) Fe/W (1)
Philippines	Fe/Cr Fe/Si
Republic of Korea	Fe/Mn Fe/W
South Africa	Fe/Cr
Zimbabwe	Fe/Cr (2)
Egypt	Fe/Si
Nigeria	Ferro-mobium
Turkey	Fe/Cr Fe/Si

Source: Metal Monthly Bulletin, September 1977, C.I.D.

(a) The number of plants producing ferro-alloys is shown in brackets.

31. Ferro-alloy production is being redeployed towards alloying-metal producing countries with good supplies of energy, or towards basic metal producers(21), but the new plants require considerable investment (i.e. US$ 400/tonne for ferro-manganese). American, European and Japanese steel producers with close control over production techniques are moving carefully in this direction, taking account of supply security criteria as well as production costs(22). In this respect, the exploitation of sea-bed nodules will be a factor to be taken into account during the eighties, even if certain estimates put forward for 1985 seem very optimistic(23).

C. ENERGY

32. A consensus can be seen on the major importance of energy to the steel industry during the eighties.

The iron and steel industry is, in fact, a major energy consumer: in the advanced countries it is the main industrial energy consumer.

3.8% of the domestic consumption in the United States
7 to 8% of the domestic consumption in France
16 to 17% of the consumption in Japan(24)

The iron and steel industry alone consumes more energy than is used in the production of all other metals.

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(21) See Metal Bulletin, 12 October 1979.

(22) Cf. the recent closure of Ugine Aciers' plant in the Ardoise.

(23) General report to the President of the United States for the year 2000, according to which the exploitation of deposits will guarantee the United States the following from 1985 onwards:
14% of their nickel requirements
2% of their copper requirements
62% of their cobalt requirements
28% of their manganese requirements

(24) Nippon Steel News, December 1979, and "Actualités Industrielles Lorraines", November 1980, page 225.

33. The iron and steel industry is thus affected by the energy crisis, and this has led firstly to large-scale measures designed to economies on energy (the performance of Japanese companies is well known in this field) and secondly to attempt to diversify usable energy sources, such as coking coal, charcoal, natural gas, etc.

34. However, the industry is also interested in the development of a new energy source which is capable of providing new outlets which are both quantitative and qualitative. The application of new energy sources will be reflected in investments which will use steel(25). The Voest Alpine report estimates that the magnitude of these steel requirements will allow the recovery of world steel production(26).

Coking coal

35. The use of coking coal is linked with the standard route of oxygen-type blast furnace/steelworks. Although experts estimate that this system will remain predominant during the eighties it is important to ask questions about the limiting nature of coking coal supplies.

36. It will be noted that the price of coking coal has undergone a moderate increase compared with the rise in the price of oil(27).

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(25) Munich Conference, September 1980 - where the required annual investment was estimated as US$ 500 billion

(26) Voest Alpine "Contribution to the world iron and steel 1990 scenarios" by G. Meindl, July 1980.

(27) Index 1980. Institute of Economic Research, Hamburg, in Voest Alpine, op. cit., page 74.

Table 5

	1952-1956	1971	April 1979	May 1980
Coking coal	100	200	532	540
Oil	100	100	658	1,062

37. According to listed resources, there will be no shortage of coking coal(28) in the eighties or in subsequent decades. Steel industry operations broadly based on the recovery of scrap would possibly permit a reduction in the consumption of coking coal.

38. However, reserves of coking coal are very unevenly distributed. The industrialized countries control substantially all the production, whilst the majority of the developing countries (with the exception of India, China and Colombia(29)) have almost none. Thus, regardless of the abundant world-wide availability of coking coal, numerous developing countries are primarily interested in ensuring greater autonomy by the possibility of using other sources of energy, such as charcoal, hydrocarbons (natural gas) or non-coking coal (low-grade coal).

Charcoal

39. Charcoal was used for iron and steel making up to the end of the XVIIIth century (beginning of the XIXth century), but was then replaced by coke in the blast furnaces. However it is still used in some countries, mainly Brazil, and also on occasions in Argentina and Malaysia.

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(28) See "Stahl und Eisen" 28 July, 1977 - "The Economist", 17 May 1980 - in Voest Alpine, op. cit. pages 61 and 65. On the other hand, there is a problem regarding coking plants. The United States and Europe are slow in replacing their old coking plants, even more so in manufacturing new plants.

(29) In Africa, there is no coking coal except in South Africa. In any case the operation of new plants installed in developing countries to 1990 will not require more than 25-30 million tonnes of coke, i.e. much less than the requirements of Japan alone. For its part India has to import high-quality coking coal - more than 1 million tonnes were imported in 1979-80 from Australia and Canada.

During the last few years charcoal, which produces high quality cast iron, has had a new lease of life. Projects have been investigated in the Camerouns and Philippines and, in particular, in Brazil where several blast furnaces operating on charcoal are under construction (Belgo Mineira, Acesita) and where the Brazilian Iron and Steel Production Institute estimates that the production of charcoal-based cast iron should increase from a little over 4.0 million tonnes in 1980 to approximately 10 million tonnes in 1990(30), assuming rational industrial exploitation of the forests.

There is always the question of damage done to forests, either as a result of savage felling(31) and their long-term disappearance, or because of the sterilizing effect of intensive forest exploitation on the soil, leading finally to the same result.

40. Whatever the circumstances, it is probable that the use of charcoal as a reducing agent will open up a channel for certain countries in Africa (Camerouns project), America (Honduras project) or Asia (Malaysia and Philippines) located in the tropical zone, by permitting them to start up small-scale production plants in the proximity of national iron deposits based on their domestic requirements, for example in the Popular Republic of the Congo, Gabon, etc.

Hydrocarbons: natural gas

41. Examination of the 1990 projects has shown that numerous direct reduction projects were currently under way or starting in hydrocarbon-producing developing countries, 95% using natural gas. We also know that several direct reduction projects using natural gas were abandoned or frozen in the United States, Great Britain, Spain, etc., following the

(30) See IBS Congress, Rio de Janeiro, April, 1980

(31) Which allows an acceptable price to be obtained for charcoal.

increase in the price of gas which is catching up on the price of oil[32]. In fact whenever natural gas is substituted for oil it cannot be considered economic as a reducing agent. On the other hand whenever available gas is likely to be wasted, either because it is toxic, because it is difficult to find an interesting local use, or because it would be too costly to liquify it for export, it becomes a potential reducing agent of considerable interest.

This interest arises when reduction processes which are more economic in energy requirements are gradually being introduced (HYL III and MIDREX processes), and when there is no other national reducing agent. We know this to be the case with numerous Latin American, African and Asiatic hydrocarbon-producing countries.

42. Several investigations have emphasized the extent of the potential that toxic natural gas alone represents for oil countries if it were used as a reducing agent: it is estimated that the gas wasted by OPEC in 1977 would have made it possible to produce 345 million tonnes of iron sponge, 250 million tonnes of this being from Saudi Arabia, Iran, Nigeria and Algeria[33].

Natural gas continues to be wasted because it is too costly, at the present time, to envisage its liquefaction or direct export. Venezuela has shown the way by constructing its iron and steel industry on the simultaneous utilization and valorization of this gas; by so doing Venezuela, and all the oil-producing countries which are following the same path, do not appear to have been motivated by comparative and pre-existing advantages. They are implementing a new and deliberate long-term strategy.

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(32) Orders of magnitude of corresponding prices (per 10^6BTU):
Oil > US$ 6.0
Gas > US$ 4.0
Coal > US$ 2.0

(33) Stahl und Eisen, 25 August 1980. World development of iron sponge production.

Non-coking coals (low-grade coals)

43. Numerous direct reduction processes based on the use of non-coking coal are available: however at the present time these processes have only been used on a limited scale industrially (approximately 5% of all direct reduction projects). Nevertheless, numerous countries which have no coking coal possess non-coking coal (including low-grade coals). It must not be forgotten in this respect that non-coking coals are increasingly likely to be sought as a replacement for oil and oil products in the production of thermal energy. Thus, the price of coal capable of being converted to coke may tend to follow the price of oil more closely than the price of coking coal, so that direct reduction using coal will be affected by an increase in the price of energy(34).

It nevertheless remains a fact that the use of non-coking coal constitutes, and will constitute, an interesting possibility for developing countries which have no other resources. Those responsible for technical management must pay attention to coal-based direct reduction processes so as to ensure that they are applied under conditions of maximum efficiency and economic performance. This question is still far from being resolved(35).

44. In conclusion, energy represents a constraint for the iron and steel industry. Coking coal exists, but the increase in price (although alower than the increase in the price of oil) leaves one to assume that energy costs in iron and steel production will tend to increase (more than 20% of the cost of the steel at the present time).

(34) Voest Alpine Report, doc. cit.

(35) In spite of advances which seem to stand out in this field. See new Korf, DRC, etc. processes.

45. Countries which have no coking coal may overcome any subsequent constraints:

- by using charcoal: its use is however limited by ecological considerations and the social cost,
- by using natural gas, where the price of the gas used is lower than the price of oil and maintained around \$0.3 to \$0.6/10^6BTU (i.e. the equivalent of \$1.7 to 3.4/barrel of oil[36]),
- by using low-grade coals on the condition that their price is lower than the price of steam coal, and that reliable processes are developed,
- and on the assumption that the use of other reducing agents (i.e. plasma arc and nuclear energy) cannot become effective before the next decade[37].

Water

46. Water is an essential raw material in iron and steel production. From 80 to 300 m^3 of water are required to produce 1 tonne of crude steel[38]. To the extent that only 3 m^3 of this quantity is evaporated, it is possible to reduce considerably the quantity of water used (below 20 m^3/tonne of steel) by means of recycling operations, the cost of which is obviously more than progressive. Assuming a consumption of 20 m^3 of water per tonne, 40,000,000 m^3 per year is required to operate an integrated complex producing 2.0 million tonnes of steel. 40,000,000 m^3 corresponds to the consumption of a town of 800,000 inhabitants at a rate of 150 litres per inhabitant per day, or the irrigation of 4,000 to 5,000 hectares capable of producing an annual harvest of cereals

(36) See J. Astier in SEAISI Quarterly, October 1980, page 24.

(37) Regardless of the interest in the new Swedish process based on the use of plasma arc.

(38) See "Environmental control in the iron and steel industry". IISI Brussels, 1978, and "Environmental pollution control in the iron and steel industry", Jack B. Carmichael, 1978, UNIDO international note.

for 125,000 inhabitants (200 kg per person per year) or an annual harvest of vegetables for 2,000,000 inhabitants (75 kg per person per year)(39). It is thus a limiting factor, in particular in the Sahel desert countries and even the Mediterranean countries.

47. In these regions the constraint may be removed by desalinating sea water, provided that energy is available at a low price, for example using toxic natural gas or gas which is difficult to export. The cost of desalination must in any case be compared with the cost of more intense water recycling, but account must be taken of increases in cost arising from effluent disposal and profits obtained by the recovery of waste.

Problems of pollution

48. The reduction of pollution is an essential requirement of a "better quality of life", and is becoming more and more pressing, in particular in the more industrialized countries. In the case of steel-making this requirement also applies externally, in the protection of the environment and the urban or rural populations involved, and internally in the protection of steel workers, since thousands and sometimes tens of thousands of workers are engaged in operating steel plants.

49. It has often been assumed, explicitly or implicitly, that developing countries were ready to accept the effects of pollution as an inevitable counterpart of a rapid industrialization process.

In fact it is clear that, during the eighties, and the numerous positions taken up by the Group of 77 bear witness to this, a reduction in steel industry pollution will also become a major objective in developing countries in order to reduce urban pollution, which has already reached alarming levels, and to provide acceptable working conditions for steel workers, whilst encouraging increases in productivity.

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(39) Estimating the yields per hectare as 5 tonnes of cereals and 30 tonnes of vegetables.

50. A reduction in pollution will involve an additional cost for the developing countries, since it is estimated that anti-pollution installations represent 12 to 20% of the overall investment in advanced countries. This cost will increase the problem of financing steel works. On the other hand it will ensure additional profit due to the reduction in water consumption and the recovery of materials, i.e. coke by-products, dust, metals, etc.(40)

Thus, in the end, it must be noted that a reduction in pollution is only one of the aspects of technical and economic management of the iron and steel manufacturing system.

D. SUMMARY

51. The dossier on materials and energy allows the following hypotheses to be put forward for 1990:

a) The partial separation between iron and steel production and supplies will continue: the increase in coastal installations is a sign of this.

b) Reserves of iron ore are almost inexhaustible: on the other hand, the actual opening if iron mines depends on the interest shown by steel producers. The steel industry can make its impact felt upstream in this way.

c) Scrap is rich in energy, and more and more industrialized countries will use it as a raw material in the future.

d) The production of alloy steels will tend to shift towards those owners of ore which have good supplies of energy.

(40) It has been estimated that the French steel industry could recover approximately 35,000 tonnes of lead and zinc.

e) The price of energy will continue to increase during the decade, and there will be an intense struggle to conserve energy during this period.

f) Coking coal will continue to be the main form of energy in steel production; there are abundant reserves of coking coal, but its price will tend to follow the price of oil, possibly with some lag. Developing countries which have no coking coal (with the exception of Colombia, India and China) will be able to overcome this operating constraint by using charcoal, or to a large extent by using non-exportable natural gas.

g) The supply of water in desert, semi-desert or Mediterranean countries, and the struggle against pollution in general, will involve considerable additional costs.

52. These developments highlight the following problems:

a) the financing of iron ore mines;

b) the exploitation of local deposits which do not meet international standards;

c) the supply of ferro-alloys for the iron and steel industries in developing countries;

d) the uncertainty regarding future transport prices;

e) the difficulties experienced by developing countries in controlling their coking coal supplies;

f) the considerable constraint experienced by countries which have neither coking coal nor natural gas;

g) the use of charcoal as a reducing agent in small plants in tropical regions, and the maintenance of ecological balances;

h) the financing of water recycling, and the struggle against pollution.

53. The "dossier" allows the following international negotiating objectives to be identified:

a) Whilst it is very probable that during this decade no cartel of iron ore producers will be established, thus improving prices and permitting capital to be provided for opening new mines, links made between oil countries producing iron sponge and high grade iron ore show that possibilities exist for building future South-South relationships.

b) Several iron ore mines (particularly in Africa) are waiting to be put into operation. Their situation should be the subject of consideration and negotiation on the basis:

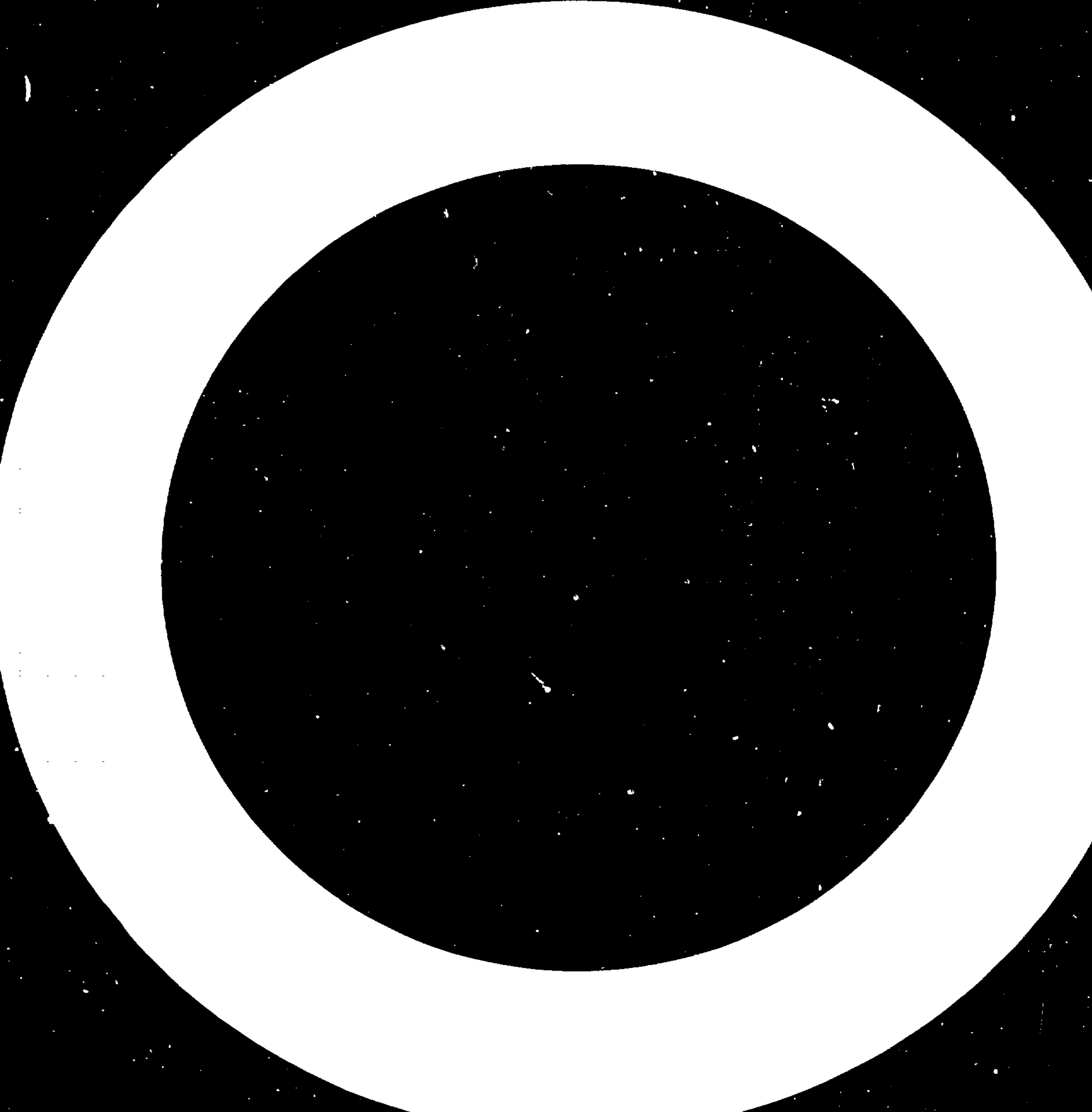
   - of the development of African economies,
   - of evaluations of iron ore requirements by the end of the decade (risk of a shortfall).

c) These new relationships could be established:

   - between oil countries and existing or potential iron ore producers for supplies of ore in exchange for capital (mining investments) or supplies of sponge iron;
   - between oil-producing countries and developing countries which have neither iron, coal, or hydrocarbons: the oil countries would contribute supplies of iron sponge, thus permitting these countries to supply their semi-integrated plants without having to depend on the fluctuating conditions of the world scrap market;

d) South-South cooperation (the exchange of information and technical assistance) could also involve the use of charcoal as a reducing agent in certain tropical zones: Brazil has already acquired experience in this respect.

e) The recovery of "toxic gas" and its use in the iron and steel industry should be considered not only in the narrow sense of apparent profit, but within the framework of efforts to prevent wastage of resources on a world scale.



MARKETS, PRODUCT RANGES AND SCALE ECONOMIES

A. EXTERNAL MARKETS: THE TREND IN INTERNATIONAL TRADING IN STEEL PRODUCTS

1. Exports of iron and steel products have undergone a rapid increase since 1950.

	in 10^6 tonnes (1)
1950	20.5
1955	34.0
1960	52.7
1965	78.5
1970	117.5
1975	148.2
1979	181.7

2. Their rate of increase has exceeded the rate of increase in iron and steel production. This was equal to the average rate of increase of international trading in 1967 and 1974, but slightly less during the period 1974-1977.

(2)

Average annual rate of increase in world trade		
	Iron and steel products	All products
1967-1974	9.3	9.3
1974-1977	5.7	7.4

3. This slowing-down is explained by a pronounced decline in internal trading between market economy countries (60% of total trade in 1972 to 49% in 1977, partially offset by an acceleration in trade towards developing countries and countries with centrally planned economies) (3).

(1) IISI statistics

(2) UNIDO documents on the general development of industry (ICIS), Global and Conceptual Studies Section.

(3) Trends in the market for finished and semi-finished products of iron and steel, 1972-1977.

In any case, the proportion of exports in world steel production has steadily increased:

	as %
1950	10.7
1955	12.6
1960	15.9
1965	17.2
1970	19.7
1975	22.9
1979	24.9

4. Between 1970 and 1979, flat products continued to represent approximately 45% of the trade. However, their relative share, and the share of ingots and semi-finished products, declined, while the share of long products increased slightly, and the share of pipes and tubes rose from 12.5% in 1972 to 16.4% in 1979 (Tables 1 and 1a)[(4)].

	Ingots, semi-products and rails	Long products	Flat products	Pipes and tubes	Total
1970	11.5	29.4	46.6	12.5	100
1979	6.9	31.8	44.9	16.4	100

5. During the period 1970-1979, the respective weights of the major exporters changed considerably: Europe and the United States represented 87.1% of world exports in 1950, but their share had fallen to 48.1% in 1979, the balance being taken by Japan, other European countries, the USSR and European countries with a centrally planned

(4) Other statistics available for 1972 and 1977 (Economic Commission for Europe) show approximately the same tendency, i.e.:

	Ingots and semi-finished products	Long products	Flat products	Pipes and tubes	Total
1972	14	30	45	11	100
1977	17	33	38	12	100

economy, and to a lesser extent by the developing countries (Diagram 1).

6. During this period, the respective weights of <u>importers</u> also changed (Table 2).

7. Apart from Japan, the weights of the main steel producing regions increased (Diagram 2).

	1950	1979
EEC	19.2%	29.0%
United States	7.0%	11.4%
USSR and Eastern countries	4.8%	13.5%

whilst the relative weights of other countries and developing regions dropped, except for Asia (Table 2, Diagram 2).

8. Within the framework of this trend in international trade in iron and steel products it is useful to specify the part played by the developing countries.

9. In the first place developing countries are steel importers. Their imports rose from 14,023,000 tonnes in 1970[5] to 33,133,000 tonnes in 1979 (Tables 3 and 4).

These imports represented:

15.2% of the world total in 1970,
25.3% of the world total in 1975,
23.5% of the world total in 1979.

The increase was faster for long products and pipes than for semi-finished and flat products.

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(5) Not including Southern Europe

10. Exports from the developing countries are tending to increase, but are relatively small:

2.6% of world exports in 1970,

2.2% of world exports in 1975,

5.6% of world exports in 1979(6)

11. The overall steel trade balance for the developing countries showed an increasing deficit during this period:

11,582,000 tonnes in 1970

26,401,000 tonnes in 1975

25,392,000 tonnes in 1979.

12. This data may be interpreted as follows:

- Imports satisfy a large part of the consumer requirements in developing countries, and the propensity to import is 17 to 20% for Latin America, 45 to 60% for Africa, 50 to 70% for the Middle East and approximately 37% for Asia.
- The propensity to export is tending to increase, in particular from 8.1% in 1970 to 9.1% in 1979 in Latin America and from 13.7% in 1970 to 17.9% in 1979 in Asia.
- Certain developing countries are becoming net exporters(7): Brazil, a net exporter in 1979 with a positive balance of 864,000 tonnes (exporter in 1970, but net importer in 1975);

(6) The relative share of the various product groups having evolved as follows between 1972 and 1977 (as a percentage of world exports)

	Ingots and semi-finished products	Long products	Flat products	Pipes and tubes
1972	1	2	1	2
1977	4	3	1	3

(after EEC statistics, Geneva)

(7) At least in weight, if not in value.

Chile, a net exporter in 1979 with a positive balance of 44,000 tonnes (net exporter from 1975);

Mexico, net exporter in 1970, but then becoming a net importer;

India, net exporter in 1970 and 1975, but becoming a net importer in 1979 with a negative balance of 1,544,000 tonnes;
The Republic of Korea, a net importer in 1970 and 1975, but becoming a net exporter in 1979 with a positive balance of 510,000 tonnes.

13. The production of the new iron and steel industries in the developing countries does not tend to "swamp" the markets of industrialized countries (a fear which has sometimes been expressed), because these new steel exporting tendencies are not so much the result of systematic aggressive strategies, but are caused by:

- technical constraints; when a large plant is commissioned and its production temporarily falls out of line with the rate of increase in the domestic demand;
- production quality control reasons, where the exporting of limited quantities permit the level of national production to be tested on international markets;
- currency balancing requirements, the gain in foreign currency resulting from exports of steel products tending to balance the outflow of currency necessary for imports of iron ore, coking coal and equipment;
- the signing of compensation or buy-back agreements by which imported equipment and services are paid for by selling part of the production of the new installation[8].

(8) See agreements now being negotiated in India for the VIZAKAPATNAM, MANGALORE, etc. projects.

14. Nevertheless, it will be noted with interest that certain trends seem to correspond to an intensification of regional inter-relationships, i.e.:

- the appearance of new exporters on the European periphery who prefer to direct their sales towards the EEC.

(9)

Balance of external trading in iron and steel products in 10^6 tonnes (crude steel equivalent)		
	1974	1978
Spain	- 0.5	+ 4.36
Finland	- 0.51	+ 1.00

- the orientation of Brazilian steel exports of which 88.8% went towards the American continent in 1972 (67.7% to Latin America and 21.1% to North America) but 92.8% in 1977 (38.5% to Latin America and 54.3% to North America)(10).

- or the trend in the pattern of trade in South-East and East Asia, as shown in the following tables: (11)

(9) Source: OECD, quoted by Voest Alpine, op. cit. p. 48.

(10) EEC statistics, Geneva.

(11) Forecast on demand and supply of steel in eight countries, Japan Iron and Steel Exporters' Association, August 1980.

Imports of steel products into eight Asiatic countries (ASEAN + Republic of Korea + other Asiatic countries) Growth of suppliers' shares				
	1976	1977	1978	1979 (estimate)
Japan	83	78	72	68
Other countries:	17	22	28	32
EEC	3	5	8	7
Republic of Korea	1	3	3	5
Other asiatic	1	1	4	4
Other new exporters	9	10	11	13
Others	3	3	2	3
Total	100	100	100	100

Destination of iron and steel exports from the Republic of Korea						
	1974	1975	1976	1977	1978	1979 (Jan.-June)
United States	63.7	39.7	38.3	51.9	56.7	33.7
Japan	4.2	2.6	3.1	3.3	9.3	15.9
7 other Asiatic countries	10.8	11.6	7.9	21.0	16.0	29.0
Others	21.3	46.1	50.7	23.8	18.5	21.3
Total	100	100	100	100	100	100

Destination of steel exports from other Asiatic countries						
	1974	1975	1976	1977	1978	1979
United States	42.1	10.6	19.2	21.8	24.0	5.2
Japan	4.2	4.9	0.2	1.9	4.4	25.4
7 other Asiatic countries	19.4	34.1	29.3	26.2	49.5	54.4
Other countries	34.3	50.4	51.3	50.1	22.1	15.0
Total	100	100	100	100	100	100

These trends converge: they show that Japan has lost part of its regional market to the new exporters, whilst the regional market tends to become the main outlet of these new exporters.

15. It will be recalled that the relative decline in the dominant exporters (Japan or the EEC) reflect the current change from mass exports to more qualitative exports: special steels, high tensile steels, coated sheet or products of first-stage converting, in particular welded pipes for oil and gas pipelines or weldless pipes for the oil and chemical industries, Japan being by far the leading world exporter of pipes.

It is also explained by the advantages inherent in exporting converted steel products, machinery, equipment or turnkey industrial plants, thus permitting them to be valorized. In fact, one tonne of steel processed from US$ 50 of iron ore is worth approximately US$ 500, whilst a motor vehicle is sold at a price of approximately US$ 6000/tonne, giving the following proportions[12]:

Ore	=	1
Steel	≙	10
Vehicle	≈	130

16. These trends lead one to question the internationalization content of an increasing portion of iron and steel production, gradually affecting a number of developing countries. Are these trends a result of the predominating initiative of large international manufacturing centres and trade (integrated iron and steel groups, Japanese shoshas) within the framework of the process described by P. Drucker as "production sharing" ? Alternatively, do they arise as a result of national initiatives tending to grant Brazil, the Republic of Korea, etc.[13] their own international trade and

(12) For a 4 HP vehicle (Renault 4L) weighing approximately 750 kg and valued at US$ 5000 (before tax).

(13) Cf. creation of "Interbras" in Brazil (subsidiary of Petrobras) and the creation of "General Trading Companies" in the Republic of Korea in the middle of the seventies.

information systems ? It is probable that an investigation will once again disclose the intervention of one or other in successive or simultaneous relationships of conflict and cooperation.

B. IRON AND STEEL PRODUCTION AND THE DOMESTIC MARKET: DOWNSTREAM LINKS

17. As a priority, the development of the iron and steel industry in developing countries is orientated towards meeting the domestic demand. The increasing participation of a number of developing countries in the international steel product trade, although limited in absolute value, does not contradict this orientation: in the Republic of Korea, as in Brazil or in other Asiatic countries, steel production began by meeting local requirements before turning towards overseas markets.

The structure of production and the structure of the demand

18. The development of production structures tends to reflect the structure of the demand and the evolution of this structure, although imperfectly and with a lag.

The largest needs in the least advanced countries come from the capital equipment and construction sectors which call on long products, concrete reinforcing rods, light and medium extrusions, rails and girders. The construction and agricultural sectors also call on drawn products, galvanized plate and pipes (irrigation, water supply). In oil countries with a low level of industrialization, the accent is on pipes (welded and weldless) and long products (infrastructures). The hydrocarbon and building and public works sectors are capable of absorbing more than 80% of the steel consumption (50% or more for building and public works alone).

19. As the industrial system becomes more complex, the demand for rolled products develops: medium and heavy plate for shipbuilding and the construction of medium or heavy equipment, then sheet for the production of durable consumer goods (cars, domestic electrical appliances).

This corresponds to the development of the iron and steel industry noted in the countries of South-East and East Asia:

- initially, production of simple long products for the building and public works sector, then welded pipes and drawn products, followed by thin sheet (from imported rolls) for galvanizing or tinning;
- then production of hot-rolled plate for the production of heavy and medium duty plate (Republic of Korea, other Asiatic countries);
- finally the mass production of thin sheet[14] (Brazil, Republic of Korea, Mexico, etc.).

A dynamic relationship is established between the complexity of an industrial system in an economy, the pattern of demand for steel products and, with a variable time-lag, the steel production organization.

Consumption of steel and gross fixed capital formation

20. The crisis which has affected the world iron and steel industry since 1974 has turned thoughts towards changes in the demand and towards those consumer sectors which exert a major influence on this development. The Institut International de la Sidérurgie in Brussels recently published the initial results of long-term work carried out in this field[15].

This work questions the validity of the method of forecasting demand which has been based up to the present time on a "steel consumption intensity curve", linked with per capita income trends.

(14) See "Forecast on demand and supply of steel in eight countries in 1980", August 1980, Japan Iron and Steel Exporters' Association.

(15) "Causes of the mid-1970's recession in steel demand", Brussels 1980.

It brings to light the fact that the "relationship normally accepted between the growth of the national product and the demand for steel" is uncertain(16), whilst a closer relationship exists between steel consumption and gross fixed capital formation, in particular between steel consumption and investments in capacity (as opposed to replacement or intensified technology investment)(17).

21. Mexico gives a clear illustration of the correlation between the trends in steel consumption and in gross fixed capital formation(18). This correlation is also found in many other cases, i.e. Colombia, Tunisia, etc.(19).

<u>The importance of the energy sector: new energies and the recovery of steel consumption</u>

22. The increase in oil prices has often been given as one of the major causes for the economic recession and, subsequently, the reduction in the demand for steel. Here we shall question the real impact of this event on recent trends in steel consumption, and conversely will attempt to ascertain the positive effects on the world steel industry that the forecast energy boost could trigger.

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(16) IISI, op. cit., page 46.

(17) IISI, op. cit., page 59.

(18)

	Apparent trend in steel consumption	Trend of the GFCF*	(as % of the previous year's figure)
1968	7.6	9.6	
1969	5.5	7.4	
1970	9.3	8.3	
1971	- 5.8	- 3.7	
1972	14.5	13.4	
1973	25.1	16.0	
1974	16.0	8.7	
1975	3.9	6.9	
1976	- 7.7	- 5.6	
1977	17.9	- 7.6	
1978	14.8	15.4	

Source: IISI, op. cit., page 116   * Gross fixed capital formation

(19) Cf. P. Judet: La sidérurgie de Menzel Bourguiba, 230 pages, Tunis 1967.

The IISI survey showed that the point of inflection of the demand curve preceding the appearance of the crisis itself was reached in certain zones from the end of the sixties, that is to say well before the so-called "first oil shock"[(20)].

23. However, whilst the IISI places the emphasis on the braking effect of the high cost of energy on the industrialization process (and on the recovery of investment)[(21)], other works emphasize the drive which the application of alternative energy sources is likely to give to steel investment and demand. The Voest Alpine survey uses different sources to confirm[(22)] "that the implementation of new technologies will result in a veritable investment boom in the construction of new energy (and transport) systems". This is also evident in various surveys published by the EEC, showing the expansion of all uses of steel linked with energy and transport since the eighties (production of tanks, oil and gas pipelines, electrical equipment and machinery)[(23)].

24. The Voest Alpine study was completed by a paper on "Steel production and the sphere of influence of the energy situation" presented at the meeting on "The energy situation and the iron and steel industry"[(24)]. This paper leads, in effect, to a first partially quantified inventory of the effects of the new energy situation on certain steel uses, including:

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(20) IISI, op. cit., pages 41 to 46

(21) IISI, op. cit., page 142

(22) "Contribution to the world iron and steel 1990 scenarios", July 1980.

(23) "Objectifs généraux acier 1980-1985 et 1990" - EEC, Brussels, July 1978.

(24) Vienna 7 - 11 September 1981 - "Steel production and the sphere of influence of the energy situation" - W. Nieder, Voest Alpine AG.

25. Other institutes (and the ECSC) forecast a major increase in industrial investment between 1980 and 2000, this growth being based on the development of new energy and transport systems(25). The USSR forecasts the gradual replacement of oil by gas, and the increasing use of energy in the form of electricity, all operations being reflected in an increasing consumption of steel(26).

(25) "Das Deutschland-Modell" in "Bild der Wissenschaft", 1 February 1978, and Guido Brunnes, ECSC, in "Stahl und Eisen" - 3 December 1979.

(26) Soviet journal "Energietechnik", March 1977, in Voest Alpine, op. cit., page 30.

26. This is why, in order to highlight these questions more fully, the UNIDO Secretariat has carried out a "Study of the markets created for the iron and steel sector by the development and diversification of energy production" on the basis of the IIASA energy scenarios and models. This study, which is the subject of a special publication(27), attempts to measure, in quantitative and qualitative terms, the impact of new energies on the demand for steel by utilizing at the same time:

- the report of the IIASA Energy Group published under the title "Energy in a finite world : a global system analysis",
- and the Bechtel report entitled "Resource requirements : impacts and potential constraints associated with various energy futures" - 1928.

The study, based entirely on the IIASA upper scenario, shows that:

a) "the rise in the demand for ferrous metals for energy requirements will remain overall lower than the world economic growth" (p.9);

b) the impacts of new sources of energy, such as fast breeder reactors and the liquefaction of coal, will not make themselves felt before the year 2005;

c) up to the year 2000 and, in particular, up to 1990, the requirements for steel will come primarily from petroleum and gas and then from nuclear reactors (pressurized water) but will only change slowly, as can be seen from the following table:

Steel demands for primary energy supplies

	1980	1990
Total (1,000 t)	24,580	29,351 1 (+ 19.5%)
of which		
Petroleum	11,642	13,475
Gas	6,127	7,471
Coal	286	340
Nuclear (LWR)	4,548	5,889
Hydro-electric	1,976	2,174

(27) D. Launay - August 1981

d) the demand for alloy and stainless steels will increase only slightly faster than the demand for carbon steels (21% against 19%).

The conclusions drawn from the IIASA work therefore appears to be considerably less optimistic than the work cited above. These contradictory statements call, therefore, for a more detailed examination and discussion, the more so since some recent information seems to show that the new energy situation will have a not unimportant impact on the iron and steel industry.

27. Mention has been made, for example, of the bottlenecks caused in American industry and engineering (specialized equipment relating to foundries, forging and the production of high grade steels[28]) for the start of the "Synfuel" programme.

Also well known is the shortfall which has obtained for some months on the tube market (weldless tubes, large diameter tubes) and which has resulted in a chain of initiative:

- in the United States, where the decision has been taken to construct new units for the production of tubes (US Steel - Armco Steel CFI) so as to meet the forecast requirements[29]:

	1980	1984	1985	1986	1987	1988
Capacity, 1,000 t	3,700	4,800	5,400	5,700	6,000	6,300
Forecast demand (1,000 t) (weldless and welded tubes)	4,700	7,200	7,300	7,900	8,200	8,600

- In Japan, where the major iron and steel companies are increasing their production capacities for tubes so as to meet the general requirements for export and, in particular, the needs of the United States (long-term contracts) so as to maintain their share in the exporting of weldless tubes, which rose to 50.4% in 1981[30].

(28) Cf. Business Week - November 1980

(29) National Supply Company in Metal Bulletin, 9 September 1981.

(30) Japan Economic Journal, 6 October 1981.

- In Europe, where an increase in exports of tubes of 23% has allowed Mannesmann to increase its production of crude steel by 2%.

28. Certain experts estimate that this boom will be only a passing one, and that an excess capacity in steel production is likely to lead to a collapse of the market. No sufficiently systematic study has been carried out which would make it possible to confirm or deny this. It will however be recalled that, up to 1979, it was estimated in the United States that the production capacity for tubes was sufficient, at least up to 1985[31]. It is difficult to forecast the opening of breaches through which, suddenly, all the world can enter.

29. The question is therefore quite clearly presented: what is the impact of the new energy data on the evolution of the consumers of the iron and steel industry, both in quantitative and qualitative terms. It will be noted on this point that the evolution in the tonnage of alloy-steels and stainless steels will not be sufficient to account for the qualitative evolution, since welded tubes and, even more, weldless tubes, are manufactured from high quality carbon steels, the production of which involves an advanced technical mastery. Knowing that the Japanese steel industry has been able to apply an increase in the price of their weldless tubes for export from US$ 920 to US$ 1,200 per tonne over one year, and that Sumitomo has during the last financial year obtained 90% of its profits from tube production[31], it may be asked if the impact of the new energy demands on the iron and steel industry will not tend to be reflected:

a) in an accentuation of the differentiation between those steel industries capable of delivering products (tubular), in particular of high quality, to meet the new energy requirements on the one hand and the steel industries having to undertake a long apprenticeship to arrive at this point on the other;

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(31) Cf. Business Week, December 1980.

b) in a segmenting of iron and steel production; part of this production being able to impose prices and to develop on the basis of its own profits, whilst another part of this production will experience the full force of world competition and can only continue at the price of ongoing external support.

These reflections, suggested by the energy situation, cannot be investigated; they have however to be integrated into the more general movement which is drawing the whole of the iron and steel industry towards higher quality products.

The demand for high quality

30. Iron and steel production is being drawn towards higher quality:

- on the one hand under the effect of the increasing pressure of demands for economies in energy and in raw materials. These economies in energies and raw materials arise from the combined action of improved control of production operations and the installation of new equipment. Automation, continuous working and the tightening of controls have as their effect not only economies in energy and raw materials but also the achievement of more constant and higher quality in the production. The search for energy economies results in the promotion of higher quality;
- on the other hand by the effect of the increasing demands of users.

31. The requirements of the oil companies go back some time; they are reflected in rigid standards to which the producers of tubes or pipelines have to adhere (quality of sheets and welding); these requirements are increasingly reinforced as a result of the use of iron and steel products in the arctic regions, in offshore drilling, for the production of very large diameter tubes, etc.

To the requirements of the oil companies there have been added, since the energy crisis, those of many other users of iron and steel products:

- car manufacturers, in search of lighter sheets but sheets of higher strength, or sheets having better resistance to corrosion;
- users of tins for food who, as a result of competition between aluminium and tinplate, are now interested in TFS (tin-free steel, etc.).

Users require, at the same time:

- products of increasingly high performance,
- products of constant quality,
- products at competitive prices.

32. The iron and steel industry - and it is important to emphasize this - has ceased to be a seller's industry and has become an industry where the producer can only sell his production if it corresponds precisely to the needs of the users.

One must be careful not to push this trend to the extreme, noting that not all uses of steel demand uniformly high quality products or products of absolutely constant quality.

The systematic and unnecessary utilization of American or European standards could, in fact, lead to the exclusion of local iron and steel products which are regarded as being of inadequate quality less as a function of the real needs of the user than in respect of the customs obtaining on the more sophisticated foreign markets.

The imperative of quality should not in any case become a "superstition" in regard to quality, but it must be taken into account within the framework of the increasingly close articulation between iron and steel producers and the users of its production.

33. In this context the effective articulation of production with the domestic market implies, amongst other conditions:

- The building of a sales network for handling national products, sufficiently experienced and technically able not only to know the users (private or public) and to evaluate their quantitative and qualitative requirements, but also to provide guidance and support their choices and, progressively, to be able to specify by common agreement the desired or desirable improvements[32].

- a re-evaluation of the technical coefficients used for establishing steel product requirements generated by the various types of consumption or by the fixed capital formation sectors. The rapid development of specific consumptions makes the technical coefficients, considered to be up-to-date, rapidly obsolescent. In addition the trend of specific consumptions should be followed up both from the qualitative and the quantitative aspects, taking into account the explicit standards such as the unwritten but dynamic requirements which effectively condition the use of a given steel product;

- the reinforcement of regional institutional groupings such as ILAFA, SEAISI and UAFA, providing them with the means to play a more active role in the distribution and the interpretation of information on trends in requirements in respect of the quality of products and of standards, together with the promotion of research for developing products suited to local or regional users;

- regional coordination of national iron and steel industries so as to organize, on a broader and more rational basis, the satisfaction of diversified needs in respect of quality in the converting industries downstream of production.

(32) Cf. Amsterdam Conference - Paper by K. Irvine: "Developing Steel for the Market" - September 1979.

C. SCALE ECONOMIES

34. "Drawback of size" is the title of an editorial in the "Metal Bulletin[33]" which once again draws attention to the vulnerability of large units as a result of their difficulty in adapting to rigid changes in the environment and in the demand[34]. Large iron and steel plants probably reached their maximum size in the mid-seventies, whilst mini-steel units, far from corresponding to a passing phase, have now been confirmed as a successful and lasting innovation, not only in Italy where the "Bresciani" have given proof of their vitality, but also on the European periphery in Spain and Greece, and also in the more dynamic iron and steel industries of the developing countries, even including the United States.

At the present time there are 17 projects for mini or medium iron and steel projects under study or construction in the United States (extensions for a capacity of 9,625,000 tonnes[35]) and 10 projects under study or construction in an Asian country (approximately 750,000 to 1,000,000 tonnes of new capacity[35]).

Furthermore those responsible for the Brazilian iron and steel industry have stated that the development of this industry will now place the emphasis on small and decentralized units[36].

35. Today experience shows that "scale economies" are an economic phenomenon which has to be evaluated in its overall content and not only in terms of costs per installed tonne which, theoretically, decrease. It is necessary to take account of the fact that:

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(33) 18 November 1980, page 19.

(34) Cf. Metal Bulletin of 9 May 1978 regarding the vulnerability of large units and the statement of Herr Speer (FRG) to the effect that "the new plants of tomorrow will not necessarily be synonymous with giant plants", or again Metal Bulletin, 10 July 1978.

(35) Information communicated by members of the Working Group on the Iron and Steel Industry at UNIDO/IS.

(36) Metal Bulletin, 20 January 1981.

- a large unit involves the risk of inflexibility and inability to adapt rapidly to a changing environment;
- scale economies are quickly cancelled out by low market shares or by too slow an entry into full production;
- the advantage of large size varies with the level of very high transport costs which may fully justify a small plant which could be too easily described as "uneconomic" (but in what context ?).

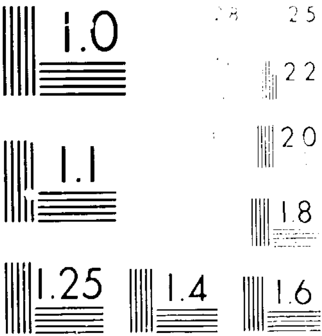
The more an iron and steel unit becomes not solely an articulated assembly of equipment but becomes a company closely linked with its upstream and downstream units, the more its efficient operation will depend on mastery of the entire system. Recent Chinese experience shows the difficulties encountered at the WUHAN plant where the hot rolling mill operates at a reduced rate due to a shortage of energy in sufficient quantity, or at the giant PAOSHAN complex where completion has been held back as a result of accumulating problems[37]. The reality of scale economies goes hand in hand with efficiency in management. This is why it is not possible to deal with scale economies without referring to instruction on size, that is to say progress in stages towards the mastery of systems.

36. This questioning of scale economies has already opened up the way, for a large number of medium and small developing countries, to enter the iron and steel industry although this would have been considered entirely impossible a few years ago. Referring to the list of projects set out above about 30 small or very small iron and steel units are now being constructed or studied*. This is an important advance, the more so since a mini-industry can be integrated into various routes:

(37) Cf. Financial Times of 14 November 1980 and Metal Bulletin of 20 January 1981: the second stage of the complex has, for the present, been cancelled.

* Excluding those units in course of realisation in other Asian countries, in the Republic of Korea, in India, Brazil and Mexico.

82 05 28


1.0
2.8
2.5
2.2
1.1
2.0
1.8
1.25
1.4
1.6

a) Electric furnace, supplied with scrap

b) Electric furnace, supplied with pre-reduced ore,
but also;

c) small blast furnace, using coke like El Foulaah in Tunisia (400 t/oven)
or using charcoal, of the Brazilian or Malaysian type (150 t/oven)
followed by an LD steel works

d) Open hearth furnaces generally regarded as on the way to disappearance, but the flexibility of which (use of scrap and cast iron) and ease of operation have retained the attention of Algeria which is now doubling the capacity of its WAHRAN unit (45,000 tonnes x 2 = 90,000 tonnes) by building a new open hearth furnace.

37. The promotion of mini-plants in the developing countries does however call for some clarification in regard to the size, cost and viability.

The mini-plants in the Brescia region in Italy have an average capacity of 100,000 tonnes a year, 50,000 tonnes per year seeming to constitute a threshold.

The new American mini-plants are developing capacities of 300,000 to 500,000 tonnes per year. This is also the capacity of the mini-plants announced by the USSR. This confirms the impression that the mini-iron and steel industry, starting from capacity levels of 100,000 tonnes a year or less, is now tending towards considerably higher levels.

In a large number of developing countries smaller dimensions can be seen with projects of capacities of 50,000 tonnes or less per year, falling to 20,000 and even 10,000 tonnes per year in several African countries.

It does not seem, however, that the conditions of viability of these micro-plants will be entirely satisfactory: whereas the mini-iron and steel industries established in Italy, Europe or in the United States have a cost per tonne installed which is less than US$ 500 the cost of a micro-plant with a capacity of 20,000 tonnes per year can rise to more than US$ 2,000 per tonne: this is reflected in amortization and financial costs reaching US$ 300 for each tonne produced, in this way exceeding the cost of a tonne of concrete reinforcing rod on the world market.

This indicates that the possibilities opened by the mini-iron and steel units should be listed with care, taking into account:

- <u>all the possibilities offered</u> not only by the technique of the electric furnace supplied with scrap or pre-reduced ore, but also employing the technique of small blast furnaces using either coke or charcoal, and also employing the open hearth furnace technique,
- <u>conditions of economic viability</u>, and, in particular, the minimum size below which it is inadvisable to fall. Is the "threshold" around 50,000 tonnes per year, or is it possible to reduce this even lower, and if so to what level ?

At all events it will be recalled, in this respect:

a) that the only processes for direct reduction suitable for sizes of less than 100,000 t per year are:
   - either direct reduction processes using coal, which are still often in an experimental stage,
   - or processes for direct reduction using natural gas of the "Kingkor Metor" type, the applications of which outside Italy are still limited to a single unit in Burma (20,000 t/year),

b) that the supply of scrap for an electric furnace, even of modest capacity (20,000 t/year) is a difficult problem in a small and little-industrialized country.

Identification of the conditions of viability for mini and micro-plants is a necessary undertaking which needs to accompany the new impulse given to the research on miniaturization of iron and steel production.

For, if the interest of the industrialized countries is satisfied with a relative "miniaturization" of production units for concrete reinforcing rods of 100,000 to 500,000 tonnes, and well adapted to the size of regional markets, numerous developing countries need, as a function of much more reduced markets, new solutions which would involve, amongst other things:

- the miniaturization of entire integrated or semi-integrated production units down to 50,000 and even below 50,000 t/year;
- by the development of direct reduction units corresponding to these dimensions;
- by the development of rolling mills for flat products making it possible to utilize production capacities going down to less than 200,000 t/year (of the Steckel-Sendzimir type).

It will also be necessary for priority orientations to be given to research, considering the preoccupations and interests of the most unfavoured developing countries before looking at those preoccupations and orientations which have normally been dominant.

D. SUMMARY

38. The "Markets, product ranges and scale economies" dossier identifies the following trends:

a) International trading in iron and steel products continues to develop more rapidly than production itself. The influence of the major exporters is tending to decline relatively. New exporters are appearing, amongst which are certain developing countries whose participation in international trading remains marginal: taken overall the imports of this group of countries are clearly increasing.

b) Nevertheless it does not seem that, in the next ten years, these new exporters are likely to upset the international markets. The appearance of these new exporters corresponds to the intensification of regional interrelations, suggesting the outlines of more marked regional groupings. The trend towards a reinforcement of the regionalization of international trading is a hypothesis which may be envisaged.

c) The growth of the demand and consumption of steel is closely linked with gross fixed capital formation; several factors lead one to think that investments devoted to energy will, in this field, exercise a particularly sharp impact. A considerable debate is open on this subject and should be conducted systematically.

d) The growth of the iron and steel industry is, however, marked by "imperatives of quality". The development of iron and steel production capacities will pass through the state of satisfactory articulation with an increasingly stringent demand.

e) Scale economies have ceased to constitute an absolute barrier to entry into the industry. Possibilities are open for the economic creation of small units using the following routes: scrap-electric furnace, direct reduction-electric furnace or small blast furnace (charcoal)-LD converter. These possibilities need to be identified and delimited with accuracy so as to remove any ambiguity on what may be termed the "mini-iron and steel industry".

39. The dossier raises the following <u>problems</u>:

a) The impact of new energy development on iron and steel production poses the following questions which have to be clarified:

- to what extent will this have an effective impact ? And from what date ?
- to what extent will it benefit the iron and steel industries in the developing countries ? (qualitative requirements of capital goods required in the sector).

b) Downstream requirements "are pushing the steel industry towards high quality" in such a way that the links between local demand and iron and steel production are not achieved in an automatic manner: it is necessary to identify the conditions and the practical means for such a harmonization so as to implement them.

c) Mini and medium steel industries open up new possibilities. How can they be integrated into the "full-scale" route, both downstream by the production of flat products, and also upstream as a result of the development of direct reduction modules of small size (100,000 tonnes/year or above). Is it possible to go down to economically viable units with a capacity of less than 50,000 tonnes per year: perhaps to 20,000 tonnes per year ?

40. Study of this dossier makes it possible to identify several fields which are capable of forming the subject of discussions and negotiations between the partners:

a) Increasing difficulties in financing iron and steel industries in the developing countries, and the appearance of new exporting countries, underline the possible interest in compensation and buy-back agreements linking (partial) payment for the supply of equipment and services in the form of products manufactured by the new plant (cf. the recent agreement signed between the Portugese iron and steel industry and the Italian contractor ITALIMPIANTI)[38].

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(38) Cf. Metal Bulletin of 30 January 1981.

b) The central role which hydrocarbons will continue to play during the eighties and beyond reinforces the position of the oil-producing countries; the assets which they have allow them to negotiate the increasing complexity of their iron and steel production in the direction of products suited to the expansion of the energy sector (tubes, pipes, etc.). The resources which the oil countries have are also able to contribute to the development of such productions in the more advanced iron and steel industries of the "South".

c) During this decade several small countries will become producers of hydrocarbons; other African, Asiatic and Latin-American countries have, in addition, forest resources: a market could therefore open up in regions where no scrap is available for units which are integrated upstream on the basis of direct reduction. Small blast furnaces using charcoal also present possibilities, provided that the supply from the suppliers is enlarged down to small sizes(39). From this point of view South-South cooperation is possible between the more advanced countries (India and Brazil) and the oil-producing countries which are able to give financial support to research and development.

d) Research should be pursued or undertaken on the miniaturization of size. This is of interest to many developing countries but also for the extension of the market for equipment suppliers.

(39) Cf. The interesting paper presented at the meeting of the Brazilian Steel Institute (April 1980) on charcoal blast furnaces and the Brazilian ability to construct such blast furnaces.

Table 1

World-wide exports of steel by products

(1000 tonnes)

	1970	1972	1974	1976	1978	1979
Ingots and semi-products	6,651	4,696	6,297	6,795	5,333	5,604
Track (rail) equipment	668	663	995	1,188	951	1,038
Extrusions	6,592	7,877	10,984	10,052	10,425	9,831
Square and round bars	6,636	7,071	12,180	10,785	10,504	12,502
Wire rod and wire	5,387	6,208	8,256	7,419	8,239	8,158
Long products	18,615	21,156	31,420	28,256	29,168	30,491
Plate and strip	29,599	35,432	45,202	38,843	44,030	42,938
Pipes and tubes	7,724	8,605	12,848	13,530	15,789	15,482
Total	63,257	70,552	96,762	88,612	95,271	95,553

Source: IISI, Steel Statistical Yearbook, 1980

Table 1/a

Structure of world-wide steel exports by products

(percentages)

	1970	1972	1974	1976	1978	1979
Ingots and semi-products	10.5	6.7	6.5	7.7	5.6	5.9
Track (rail) equipment	1.1	1.0	1.0	1.3	1.0	1.1
Extrusions	10.4	11.1	11.4	11.3	11.0	10.3
Square and round bars	10.5	10.0	12.6	12.2	11.0	13.1
Wire rod and wire	8.5	8.8	8.6	8.4	8.6	8.5
Long products	29.4	29.9	32.6	31.9	30.6	31.9
Plate and strip	46.8	50.2	46.6	43.8	46.2	44.9
Pipes and tubes	12.2	12.2	13.3	15.3	16.6	16.2
Total	100.0	100.0	100.0	100.0	100.0	100.0

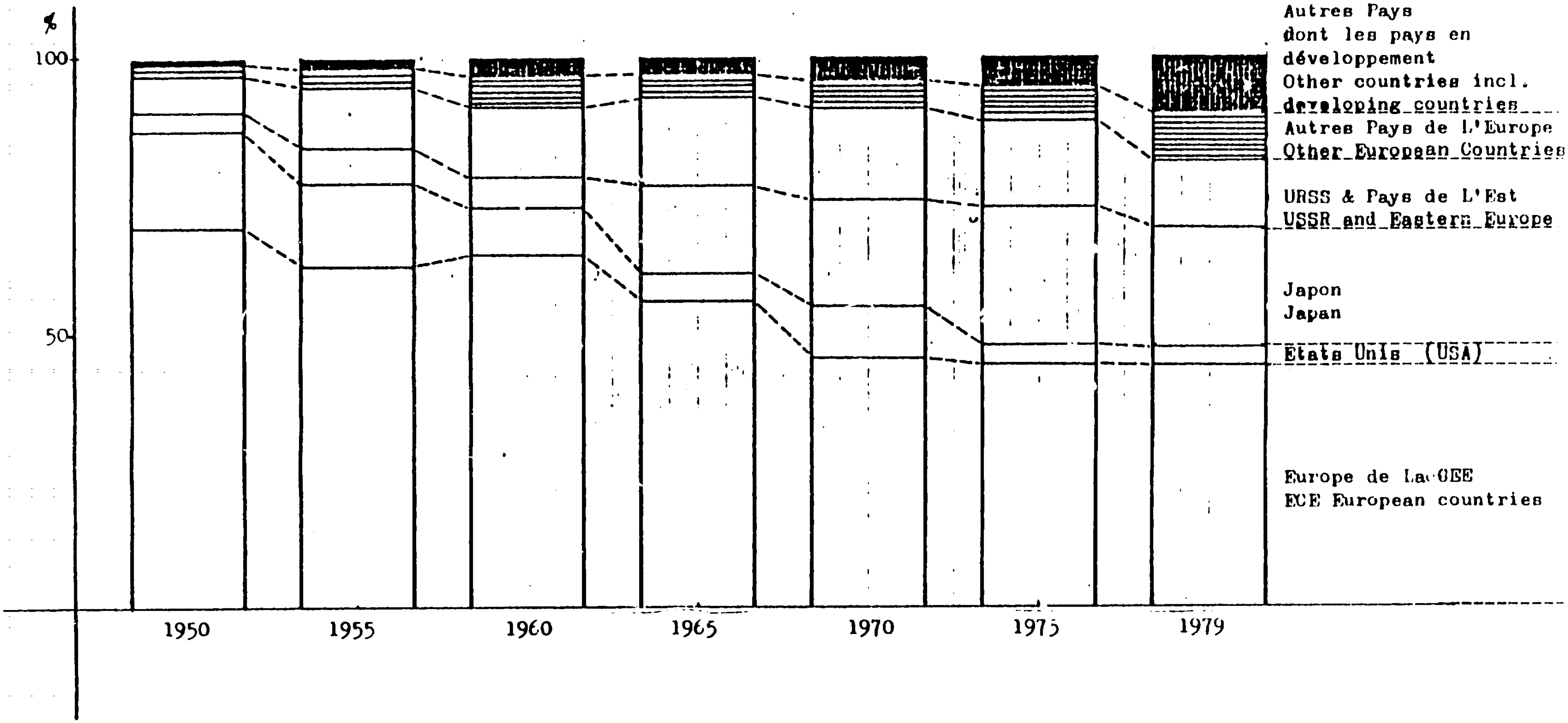
Source: IISI, Steel Statistical Yearbook, 1980

Graphique 1

Diagram 1

Structure des Exportations Mondiales de l'Acier 1/

Structure of the World-wide Exports of Steel 1/



Source: IISI, Steel Statistical Yearbook. 1980

1/ Les échanges intra-européens et intra CEAM compris.
Inter-european and inter-CMEA exchanges included.

Table 2

Structure of world-wide steel imports and exports by regions (*)

Exports

(as percentages)

	Europe (EEC)	United States and Canada	Japan	USSR and Eastern European countries	Other European countries	Other countries (a)
1950	69.6	17.5	3.4	7.1	1.9	0.5
1955	62.7	15.6	6.8	10.9	3.2	0.7
1960	64.5	8.6	5.5	13.2	6.2	2.0
1965	56.0	5.1	16.0	16.2	4.5	2.2
1970	45.8	8.9	19.4	16.6	5.1	4.2
1975	44.9	3.6	25.4	15.3	6.4	4.4
1979	44.3	3.8	22.0	12.5	8.9	8.6

Imports

	Europe (EEC)	United States and Canada	USSR and Eastern European countries	Other European countries	Latin America	Africa and the Middle East	Asia	Other countries
1950	19.2	7.0	4.8	14.4	13.4	13.8	11.7	15.6
1955	31.4	2.9	6.4	13.5	12.7	10.5	11.9	10.7
1960	33.3	6.7	15.2	12.1	7.4	8.3	10.2	6.7
1965	27.8	14.8	13.3	12.5	5.2	8.1	8.5	9.9
1970	34.7	13.1	13.1	11.9	3.7	6.9	9.5	7.0
1975	26.6	9.4	16.7	10.9	7.6	12.5	10.9	5.3
1979	29.0	11.4	1[illegible].5	8.5	4.9	9.6	16.6	6.5

Source: IISI, Statistical Yearbook, 1980

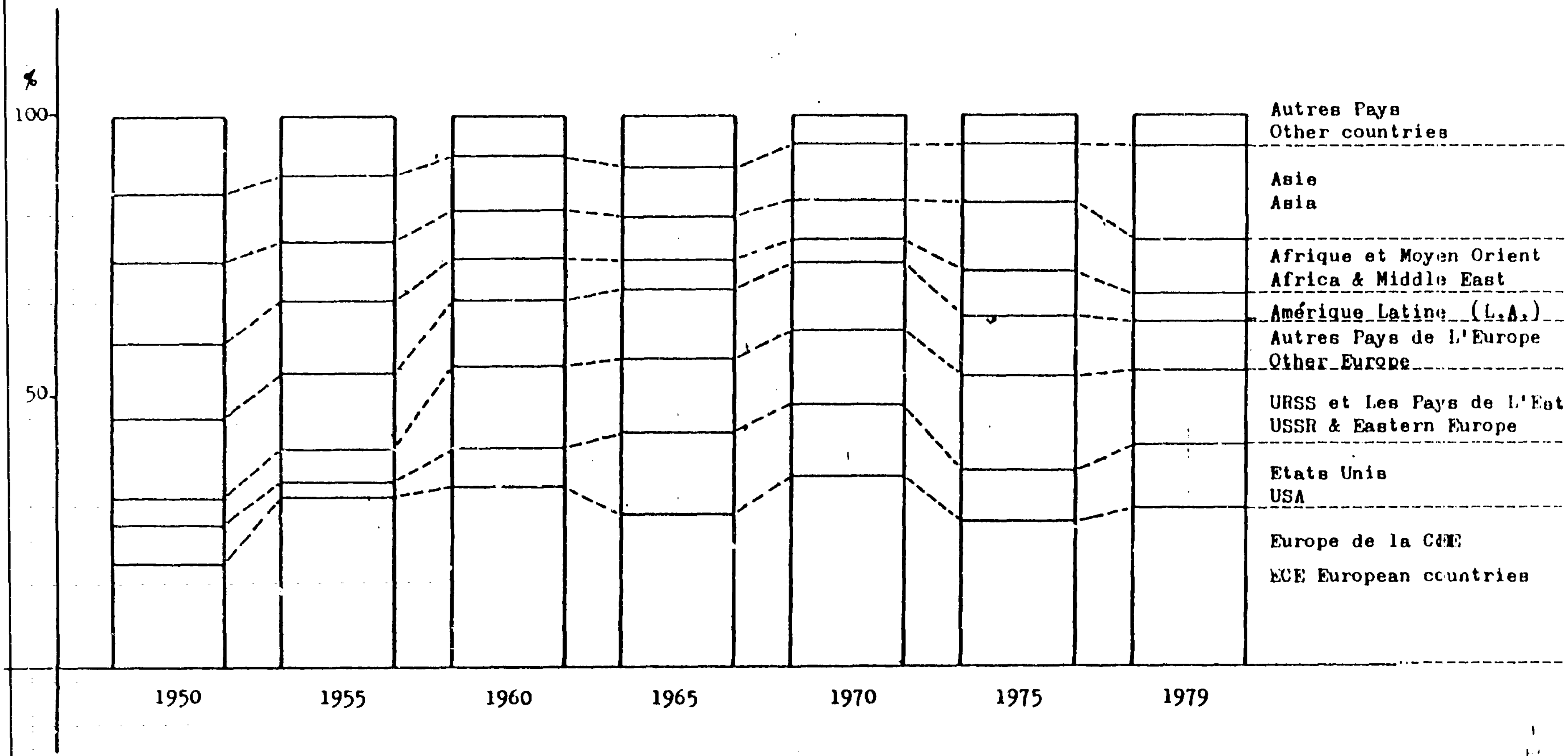
(*) Inter-European and inter-CEAM exports and imports included

(a) Including developing countries

Graphique 2

Diagram 2

Structure des Importations Mondiales de l'Acier 1/
Structure of the World-wide Imports of Steel 1/



Source: IISI, Steel Statistical Yearbook, 1980

1/ Les échanges intra-européens et intra-CEAM compris.
Inter-european and inter-CMEA exchanges included.

Table 3

Imports and exports: developing countries

(1000 tonnes)

	Imports			Exports		
	1970	1975	1979	1970	1975	1979
Southern Europe	1,222	2,824	2,545	220	375	582
Latin America	3,135	8,069	6,348	1,060	372	2,479
Africa	2,592	3,286	3,456	-	-	-
Middle East	2,668	9,472	9,498	-	-	-
Asia	5,628	8,103	13,831	1,381	2,157	5,262
Total for developing countries	15,245	31,754	35,678	2,661	2,904	8,323
World total	90,396	113,987	139,764	90,396	113,987	139,764
Percentage	16.9	27.9	25.5	2.9	2.5	6.0
Total for developing countries (excluding Southern Europe - percentage	15.2	25.3	23.5	2.6	2.2	5.6

Source: IISI, Steel Statistical Yearbook, 1980

Table 4

Imports and exports of steel: developing countries

(1000 tonnes)

Countries	Imports			Exports		
	1970	1975	1979	1970	1975	1979
Greece	536	666	945	179	334	482
Portugal	439	497	650	41	26	100
Turkey	247	1,661	950	-	15	-
Southern Europe	1,222	2,824	2,545	220	375	582
Argentina	753	1,771	585	253	41	539
Brazil	579	2,889	620	583	149	1,484
Chile	91	54	32	12	89	76
Colombia	262	233	363	-	-	-
Mexico	188	696	1,573	208	67	270
Peru	174	290	80	-	-	-
Venezuela	543	1,311	1,147	-	-	-
Other Latin American countries	545	825	1,948	4	26	110
Latin America	3,135	8,069	6,348	1,060	372	2,479
Algeria	170	903	1,042			
Kenya	124	90	202			
Morocco	246	373	289			
Nigeria	469	1,030	650			
Tanzania	61	52	43			
Tunisia	54	121	2			
Zaire	131	75	24			
Zambia	45	49	-			
Other African countries	1,292	593	1,204			
Africa	2,592	3,286	3,456			

(cont'd)

Table 4 (cont'd)

Countries	Imports			Exports		
	1970	1975	1979	1970	1975	1979
Egypt	165	842	632			
Iran	947	3,993	1,482			
Iraq	339	1,485	2,097			
Kuwait	105	252	392			
Lebanon	228	234	238			
Libya	193	593	523			
Saudi Arabia	172	1,005	2,356			
Syria	206	356	646			
Other M.E. countries	313	712	1,132			
Middle East	2,668	9,472	9,498			
Hong Kong	481	491	1,375	63	27	50
India	598	723	1,604	686	739	60
Indonesia	388	963	1,302			
South Korea	600	1,677	2,678	80	931	3,188
Malaysia	366	528	800	32	14	75
Pakistan	522	405	572			
Philippines	869	596	900	99	2	20
Singapore	616	1,209	1,337	67	185	319
Other Asian countries	645	938	2,063	345	249	1,520
Thailand	543	573	1,200	9	10	30
Asia	5,628	8,103	13,831	1,381	2,157	5,262

Table 5

Steel foreign trading balance
in the developing countries
(1000 tonnes)

	1970	1975	1979
Southern Europe	- 1,002	- 2,449	- 1,963
Latin America	- 2,075	- 7,697	- 3,869
Africa	- 2,592	- 3,286	- 3,456
Middle East	- 2,668	- 9,472	- 9,498
Asia	- 4,247	- 5,946	- 8,569
Total deficit	12,584	28,850	27,355
Total deficit (excluding Southern Europe)	11,582	26,401	25,392

Source: IISI, Steel Statistical Yearbook, 1980

Table 6

Steel foreign trading balance in the developing countries
(1000 tonnes)

	1970	1975	1979
Greece	- 357	- 332	- 463
Portugal	- 398	- 471	- 550
Turkey	- 247	- 1,646	- 950
Southern Europe	- 1,002	- 2,449	- 1,963
Argentina	- 500	- 1,730	- 46
Brazil	+ 4	- 2,740	+ 864
Chile	- 79	+ 35	+ 44
Colombia	- 262	- 233	- 363
Mexico	+ 20	- 629	- 1,303
Peru	- 174	- 290	- 80
Venezuela	- 543	- 1,311	- 1,147
Other L.A. countries	- 541	- 799	- 1,838
Latin America	- 2,075	- 7,697	- 3,869
Algeria	- 170	- 903	- 1,042
Kenya	- 124	- 90	- 202
Morocco	- 246	- 373	- 289
Nigeria	- 46[illegible]	- 1,030	- 650
Tanzania	- 61	- 52	- 43
Tunisia	- 54	- 121	- 2
Zaire	- 131	- 75	- 24
Zambia	- 45	- 49	- -
Other African countries	- 1,292	- 593	- 1,204
Africa	- 2,592	- 3,286	- 3,456
Egypt	- 165	- 842	- 632
Iran	- 947	- 3,993	- 1,482
Iraq	- 339	- 1,485	- 2,097
Kuweit	- 105	- 254	- 392
Lebanon	- 228	- 234	- 238
Libya	- 193	- 593	- 523
Saudi Arabia	- 172	- 1,005	- 2,356
Syria	- 206	- 356	- 646
Other M.E. countries	- 313	- 712	- 1,132
Middle East	- 2,668	- 9,472	- 9,498
Hong Kong	- 418	- 464	- 1,325
India	+ 88	+ 16	- 1,544
Indonesia	- 388	- 963	- 1,302
Rep. of Korea	- 520	- 746	+ 510
Malaysia	- 334	- 514	- 725
Pakistan	- 522	- 405	- 572
Philippines	- 770	- 594	- 880
Singapore	- 549	- 1,024	- 1,018
Other Asian countries	- 300	- 689	- 543
Thailand	- 534	- 563	- 1,170
Asia	- 4,247	- 5,946	- 8,569

Table 7

Trends of developing countries towards foreign trading

(percentages)

	Trend towards exporting(1)			Trend towards importing(2)		
	1970	1975	1979	1970	1975	1979
S. Europe	10.2	13.3	14.3	34.3	52.3	38.7
Latin America	8.1	2.0	9.1	17.6	29.2	19.5
Africa	-	-	-	66.5	52.3	44.8
Middle East	-	-	-	51.7	72.0	65.6
Asia	13.7	14.0	17.9	37.7	37.8	38.3
Total for the developing countries	11.0	8.1	13.9	33.6	42.9	36.6

Source: IISI, Statistical Yearbook, 1980

(1) TE = Exports/Production as %

(2) TI = Imports/Production as %

Table 8

	Exports/production %			Imports/consumption %		
	1970	1975	1979	1970	1975	1979
Greece	39.8	50.2	48.2	60.7	51.6	52.1
Portugal	10.6	5.9	14.9	49.0	48.0	50.0
Turkey	-	1.1	-	13.9	54.0	27.4
Southern Europe	10.2	13.3	14.3	34.3	52.3	38.7
Argentine	13.9	1.9	16.8	22.9	41.3	16.3
Brazil	10.8	1.8	10.7	9.5	25.7	4.9
Chile	2.0	17.5	11.8	11.4	9.6	4.6
Colombia	-	-	-	38.2	27.0	50.4
Mexico	5.4	1.3	3.9	4.5	11.2	17.8
Peru	-	-	-	37.8	29.9	14.5
Venezuela	-	-	-	33.6	55.7	40.5
Other L.A. countries	-	-	-	-	-	-
Latin America	8.1	2.0	9.1	17.6	29.2	19.5
Algeria	-	-	-	23.1	64.3	49.7
Kenya	-	-	-	-	-	-
Morocco	-	-	-	73.7	76.4	41.3
Nigeria	-	-	-	72.2	74.6	63.4
Tanzania	-	-	-	-	-	-
Tunisia	-	-	-	31.2	37.6	0.3
Zaire	-	-	-	-	-	-
Zambia	-	-	-	-	-	-
Other African countries	-	-	-	-	-	-
Africa	-	-	-	66.5	52.3	44.8
Egypt	-	-	-	17.9	53.2	45.1
Iran	-	-	-	54.4	74.2	48.1
Iraq	-	-	-	75.5	73.9	76.8
Kuweit	-	-	-	47.9	71.2	77.5
Lebanon	-	-	-	82.6	80.4	55.5
Libya	-	-	-	47.3	75.7	62.2
Saudi Arabia	-	-	-	40.0	71.3	63.1
Syria	-	-	-	76.3	75.9	63.4
Other M.E. countries	-	-	-	-	-	-
Middle East	-	-	-	51.7	72.0	65.6
Hong Kong	63.0	22.5	41.7	74.3	67.7	74.7
India	10.9	9.2	0.6	9.3	8.5	13.3
Indonesia	-	-	-	65.0	66.5	64.9
Rep. of Korea	16.6	46.7	41.9	46.9	53.8	38.5
Malaysia	26.2	7.6	36.2	60.4	71.0	76.2
Pakistan	-	-	-	75.0	75.4	76.3
Philippines	88.4	0.6	5.0	64.3	54.8	58.4
Singapore	58.8	98.4	(*)	77.0	(*)	(*)
Other Asian countries	98.6	24.6	35.8	ND	ND	ND
Thailand	5.9	4.0	6.8	68.5	51.7	63.2
Asia	13.7	14.0	17.9	37.7	37.8	38.3

(*) transit zone

DOSSIER IV

TECHNOLOGY AND RESEARCH

Certain statements on the iron and steel industry have recently suggested that it could be following the same pattern of development as the railways[1]. As a basic activity, providing industry with essential products, it is now an old industry which has matured and is declining: more and more of a liability, less and less profitable, it is gradually being taken over by the State and will tend to become a kind of public service, offering users a standard product based on slow technical development. Today specialists from all sources are disputing this opinion, regretting "that decision-makers and a number of theoreticians should talk as if the steel industry had reached its peak or is in decline, since this has tended to give strength to protectionist policies and to compromise adjustment processes", hoping that "those responsible would understand that steelmaking is one of the most important branches of the entire industrialized economy, and that it is destined to progress...... to the extent that its driving factors are not stifled.....".[2].

2. In fact it seems that current technical developments in the iron and steel industry do not match this image of a declining industry. Are these developments going to continue and accelerate until real technical breakthroughs are achieved? This question is asked for the eighties.

A. NO MAJOR DECISIVE BREAKTHROUGH DURING THE EIGHTIES

3. There is general agreement that there will be no new technological breakthrough of the kind of the Bessemer process, continuous wide strip mill or LD oxygen steel-making during the eighties. This is the conclusion which emerges from discussions at the Amsterdam Conference devoted to "Changes in iron and steel technology"[3]. "It is inconceivable that a radical new process

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(1) Cf. Metal Bulletin, "Off the Rails", 15 September, 1978 (editorial)

(2) Ed. Florkosky Jr.: Communication to OECD Symposium, Paris, February 1980.

(3) Conference organised by the Metal Society in September 1979.

capable of replacing the standard coking plant/blast furnace/ oxygen converter system could emerge within the next ten years"[4]. This opinion is summarized by the Voest Alpine contribution[5]; It confirms the evaluation of the Office of Technology Assessment[6] that radical changes could not occur until after 1990.

4. The following table summarizes some long-term technological forecasts:

Table 1

Radically new processes	Possible transition to a significant industrial stage		
	1985	1990	2000
Production of steel using plasma arc			?
Direct steelmaking		?	?
Continuous steel production[7]		?	?
Hydrometallurgical production of cast iron		?	X
Steel production using nuclear energy			?
Various systems using hydrogen		?	X
Top casting of steel		?	X
Coke substitute (formed coke)		?	X
Direct fabrication of rolled products using powder	X	X	X
Direct reduction process	X	X	X

Source: Report from Office of Technology Assessment (OTA) in Metal Bulletin Monthly, October, 1980.

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(4) Communication from Messrs. Sanbongi and Komada in Amsterdam.

(5) Op. cit., page 83, based on "Industrial World", July 1976.

(6) "Technology and steel competitiveness", OTA, US Congress, 1980.

(7) "Industrial World" of July 1976, cited by Voest Alpine, estimates that this process could be economically feasible (profitability stage) in 1990 and become a standard process in 2000.

B NO MAJOR BREAKTHROUGH, BUT MULTIPLE DEVELOPMENTS AND ACCELERATED IMPROVEMENTS

5. There is general agreement that, during the eighties, the predominance of the main route, coking plant/blast furnace/oxygen converter, supplemented by the scrap/electric furnace route, will be confirmed and extended.

From the beginning of the eighties Thomas and Bessemer converters and open hearth furnaces will tend to disappear completely. This process has nearly been completed in Japan.

6. Whilst the sixties were noted for the extension of mass production capabilities and the years 1974 - 1980 were a period of adjustment, the eighties should mark the entry of steelmaking into an era of "intensified technology".(8)

Within the overall stability of the main route modernization and intensification will increase, thus improving control of operations and of conversion of the installations.

7. Modification and intensification will involve the use of dry quenching in the manufacture of coke up to controlled temperature rolling, and including more accurate control of the blast furnace (pressure, temperature, distribution of the charge and gas flow etc.), and more efficient refining of steel, etc. These developments will allow the efficiency and profitable nature of the main process to be improved.

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(8) Cf. Nippon Steel News, October 1979.

Technological developments in the steel industry in the nineties.

1960 - 1974	1974 - 1980	1980
Mass production techniques	Temporary adjustments/ measures (energy problems)	Advanced technologies

8. The development of continuous pouring will signify in particular that the process has become fully developed. Continuous casting was applied to 0.3% of world steel production on 1960, and to approximately 20% in 1979. This development varied in accordance with the countries concerned.

Table 2 (9)

Percentage of steel production using continuous casting

	1972	1979
Finland	73.9	88.8
Japan	17.0	52.2
Italy	12.7	46.4
West Germany	13.9	39.3
E.E.C.	7.2	30.4
Korea, Republic of	0	30.4
Brazil	2.2	27.6
USA	5.8	16.7
USSR	5.5	9.5
Whole world	8.1	20.7

It is anticipated that at least 80% of Japanese steel will be continuously cast in 1990, a percentage which has been exceeded by the Nisshin Steel Company since 1980 (81%). By the same date Kawasaki Steel had achieved 70.3%, and Nippon Steel, Nippon Kokan and Sumitomo 60% (10), with a considerable advance over their fixed objectives. The Japanese, German, Italian and Finnish iron and steel industries have led this development, leaving the majority of the steel industries in the developing countries behind.

9. During the eighties this process of intensified and improved technology will accelerate as a result of impulses from both

(9) EEC/Steel/25, page 93

(10) Japan Economic Journal, 23 December 1980

upstream and downstream. Economies in energy and materials are imposed from upstream: steel production downstream is (and will be) increasingly drawn towards quality, in view of the emphatic demand of users in search of products provide a reduction in weight and corrosion (cars), the ability to withstand very low temperatures (i.e. transportation of hydrocarbons in arctic regions, or transportation of LNG), or very high pressures and temperatures (nuclear chemistry), etc. In addition, this tendency is linked with the willingness of manufacturers to provide cheaper steel products of a given quality such as stainless steels with a lower nickel content[11] which are easier to work, and sheet steel for cans without tin (tin-free steel), silicon-free sheet for electric motors, etc.[12].

10. These trends show the preoccupations of steel manufacturers and their customers, both being concerned with homogeneous quality, energy economy and economies in raw materials. High performance and cheaper steels are required, but with improved specifications: these two trends converge and finally merge together. In fact, they both depend on the pursuit of quality and the application of advanced technology which involves changing the priorities

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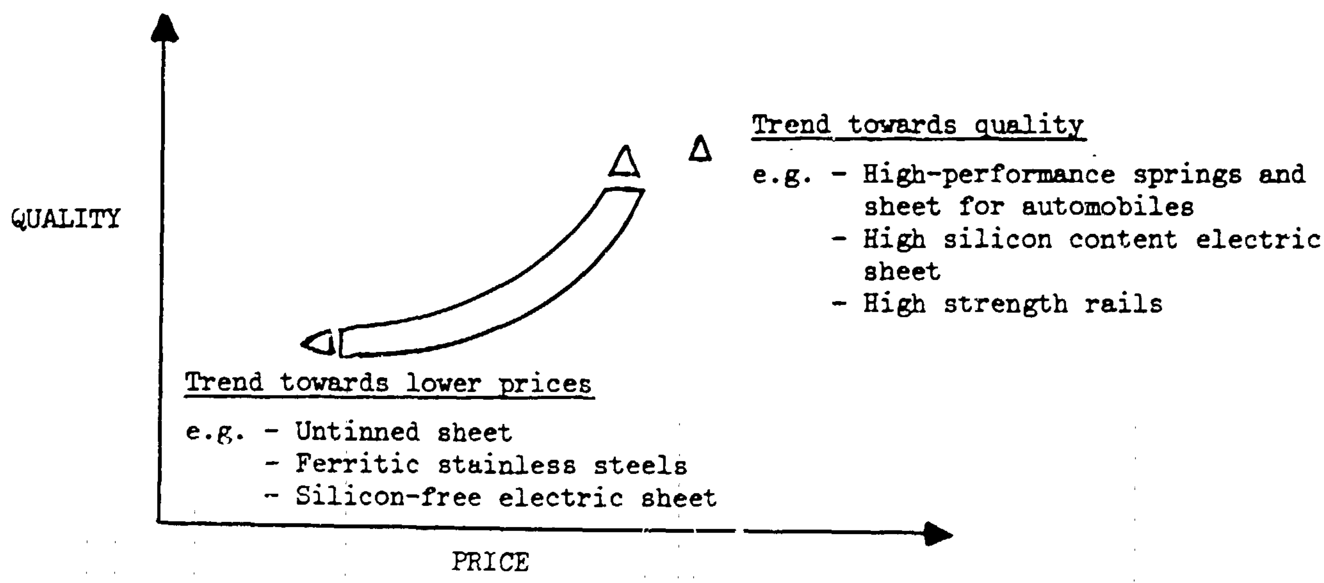
(11) By economising on metals, such as nickel, with a high energy content.

(12) Cf. Nippon Steel News, October 1979. The following diagram shows the two-dimensional effect of trends in market requirements.



specified above from the investigation of new systems and processes to the perfecting of increasingly sophisticated products which meet the new requirements.

11. Thus an outline is sketched of technical changes which will affect the iron and steel industry during the eighties. Strong impulses will be exerted from outside the industry, mainly connected with the question of energy:

- either directly, with a view to economising on energy and materials in the steel-making process itself
- or indirectly through the supply of new products complying with new conditions for the application of energy.

These external impulses will result in the appearance of new products linked with a rapid improvement in processes, internal dynamism being renewed by external pressures and vice-versa.

The Direct Reduction Process

12. The Office of Technology Assessment considers that direct reduction processes constitute one of the rare and radical technical advances of the eighties. In fact it is found (see Dossier I "Projects") that iron and steel plant projects based on a direct reduction process have multiplied durng the recent period. The majority of these projects are based on the use of natural gas as a reducing agent, in particular in the Midrex and Hyl processes which are currently subject to successive improvements, allowing transfer to continuous production and a reduction in gas consumption.

13. It is not easy to speak of "a breakthrough" in the Northern countries, where the increase in price of natural gas, which tends to fall into line with the price of oil (cf. Dossier II "Raw materials and energy") has resulted in the closure of certain plants (Oregon Steel in the United States), the freezing of projects (i.e. Hunterston Plant in Great Britain), and a loss of enthusiasm (i.e. Spain).

Nevertheless, one may question the effective impact (in the "North") of the following new techniques or processes during the eighties:

- the use of coke-oven gas for producing sponge iron[13]
- the advance of direct reduction processes using non-coking coal as a reducing agent[14]
- the use of very high temperature plasmas based on gas, coal or hydrocarbons[15].

It is probable that the rapid increase in price of energy, including non-coking coals, will not favour the general progress (the breakthrough) of direct reduction processes in the more industrialized countries.

14. On the other hand, the impressive number of new advantages from the direct reduction process in developing countries is a sign that a breakthrough is being achieved in oil countries which have an abundant supply of natural gas. This breakthrough should become even more apparent during the decade to the extent that numerous developing countries, where prospecting has been poorly carried out until now, will become oil countries. This phenomenon is occuring in West Africa, where the former oil countries of Nigeria, Gabon and Angola have new oil neighbours including the Ivory Coast, Cameroun, the Popular Republic of the Congo[16] and Zaire. These countries often have deposits of high-grade iron ore, and thus become candidates for the installation of direct reduction plants.

15. Mexico has completed its first industrial process, the HYL process; nevertheless, distribution and control of the direct reduction processes is carried out by companies from the more

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(13) See Communication from M. J. Astier, Paris, Metal Bulletin of 14 October 1980.

(14) DRC Process (Amcon, Davy MacKee), new Korf process, etc. Metal Bulletin of 21 November 1980 and 9 December 1980.

(15) Process proposed by SKF cf. SKF Steel International 6 - 15.6.1979

(16) Where production will jump from 2.0 to 7.0 million tonnes/year

15. Mexico has developed the first industrial process, the HYL process; this does not prevent the distribution and control of direct reduction processes being in the hands of companies belonging to the more advanced countries(17).

The technical breakthrough represented by direct reduction will be the more effective in those countries which do not have cheap reducing agents (natural gas), not only in the financing and construction of the project but also the development of the research aimed at giving these processes their overall extent.

C. TOWARDS THE MASS PRODUCTION OF HIGH-GRADE STEELS

The recent development of the iron and steel industry has shown, under the pressure of higher quality requirements (cf. above):

- stagnation (or falling back) in ordinary steels,
- but considerable progress in high-grade and special steels.

In Japan the respective indices for the production of these two categories of products have developed as follows*:

	1973	1979
Ordinary steels	100	84.8
High grade and special steels	100	122.9
Heavy sheet	100	56.4

More particularly the production of stainless steel has ceased to increase**, despite the crisis, since 1973.

(17) Including the HYL process, distributed jointly by the American HYLSA company and the Swindell Dresser and Kawasaki companies.

* Source: S. Hosoki and T. Kono - Amsterdam Conference 1979.

** Source: "World Stainless Steel Statistics" Inco 1979. A recent report forecast that the demand for stainless steels would increase up to 1990 at a rate of 8% per year in the developing countries (CRU).

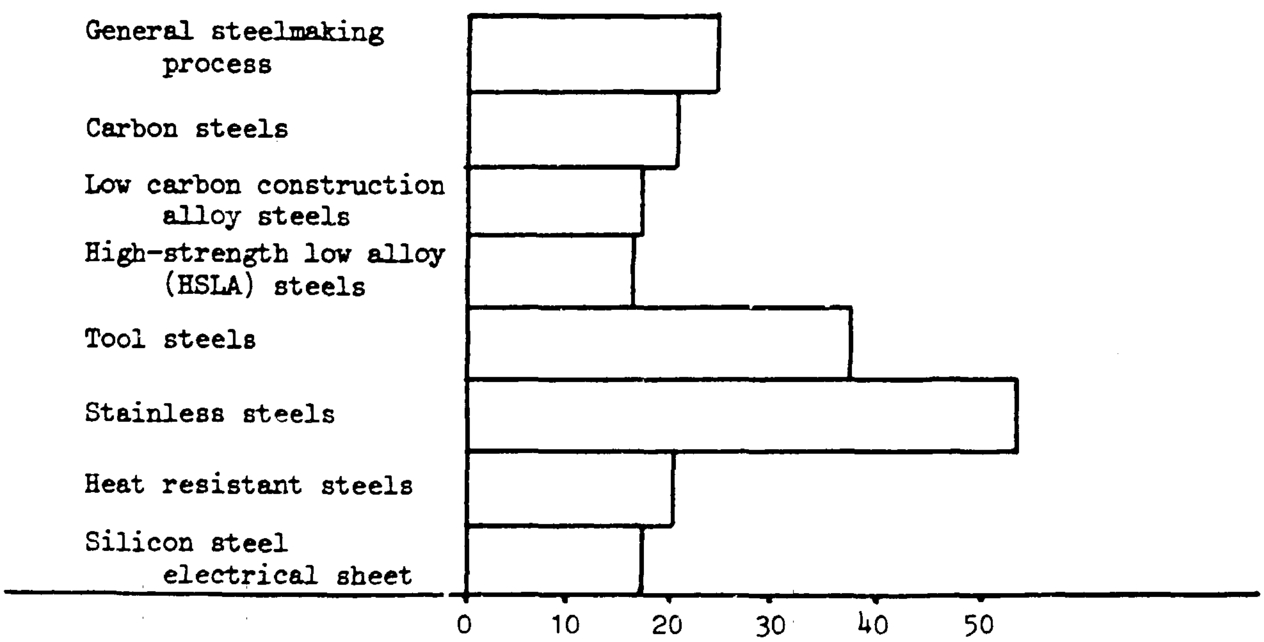
In 1,000 tonnes	1973	1979	Index 1973 = 100
USA	1,714	1,905	111
Japan	2,018	2,289	115
EEC	1,748	2,324	132
Spain	52	156	300

This pressure towards higher quality has resulted in research into new steels based on:

- resistance to corrosion (offshore oil constructions),
- uses at very low temperatures (Arctic oil),
- requirements resulting from the mass production of engineering products using steels with more stable properties (greater purity).

It is significant that between 1974 and 1976, in the American iron and steel industry, the majority of the patents were taken out in the field of special steels or the so-called high-strength steels:

NUMBER OF U.S. PATENTS GRANTED :
July 1974 - July 1976



However these high quality steels are not absolutely equivalent in the present evolution of matters to "special steels" or "fine and alloy steels". More precisely the process of intensification which is in process will either take place or not.

16. The process of intensification will be reflected in particular by a new structuring of the iron and steel industry where the distinction which up to now has been very clearly shown between the (mass) production of normal steels and the production (in small quantities) of high grade and special steels will tend to disappear as a result of the increasing possibilities offered by conventional routes for the production of high grade steels.

17. This new structuring will, in particular, involve:

- rolling at controlled or low temperatures or with controlled cooling, for example the Torsid process introduced by a group of French steel-makers[18] or the two-stage production of sheets;
- but mainly by the secondary refining of steel and ladle metallurgy[19], supplementing the oxygen steelworks (LD or OLP) or electric furnaces making it possible to obtain, in bulk, special and high quality steels[20]. The special sheet intended for the production of gas and oil pipelines for use in the Arctic will now be produced in LD steelworks of high capacity together with many grades of carbon or low-alloy steels.

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(18) Cf. Metal Bulletin, 22 February 1980

(19) Cf. K. Sanbongi, K. Komoda and T. Kono - op. cit.

Ladle degassing processes
ASEA, SKF and VAC processes
DH processes
RH processes
or AOD processes the practice of which is rapidly expanding.

(20) This makes it possible, by improving the quality, to reduce the duration of the operating cycle. Cf. Revue de Métallurgie - December 1980 or Metal Bulletin, 13 June and 14 November 1980.

18. This explains the accelerated alignment and merging of former producers specializing in high-grade and special steels and large steel undertakings having mass production capacities based on oxygen converters and high-output electric furnaces. It can be seen that "the reinforcement of links between high-grade and standard steel production is natural"(21). This movement arises from the increasing efficiency of the conventional route, culminating in the simultaneous mastery of mass and quality production to the point where it becomes infinitely more costly to manufacture numerous grades of high-grade and alloy steels in the older special steelworks than in ordinary high-performance plants(22).

D. TOWARDS NEW DIFFERENTIATIONS ?

19. This development highlights the inadequacy of any evaluation of the iron and steel industry in terms of crude steel(23), which less and less reflects the reality of the evolution of the iron and steel industry. Evaluations in terms of crude steel, which have been useful and suitable for many years, today tend to mask the possibilities of rapid increases in effective capacity (evaluated in terms of weight as well as in the quality of the finished products).

There is also the risk of masking new differentiations between the iron and steel industries in the industrialized countries and the new industries in the developing countries. This question is directly related to the implementation of the Lima objectives: what advantage would it be, in effect, to produce 25% or even 30% of crude steel if

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(21) Statement of the French Ministry for Industry in Metal Bulletin of 13 June 1980 regarding line-ups between SACILOR and Pompey, SACILOR and UGINE-ACIERS and, possibly, between USINOR and CREUSOT-LOIRE. Cf. "Le Monde", 16 April 1980.

(22) Cf. on this subject many examples in France, Austria, etc.

(23) Some estimate that one tonne of steel manufactured in the year 2000 may be equivalent to two tonnes of steel in 1974. Cf. Annales des Mines - November 1978.

this production was not directed towards the manufacture of an increasingly wide range of rolled products and high-quality steels, whilst at the same time effecting economies in energy and raw materials ? From this point of view the Lima objective needs to be qualified, from the general viewpoint of a new method of evaluating the movement of the iron and steel industry and giving preference to calculations in real terms, of final products rather than the uncertain category of crude steel[(24)].

20. This development also poses the problem of a new differentiation between:

- firstly the advanced iron and steel producers, integrated and multi-purpose, offering high quality mass production, and
- secondly the new iron and steel industries in the developing countries, overcoming with difficulty the stages between the phase of mass production to the phase of intensification.

As a bulletin of the City Bank has emphasized: "the renewal of competition on the world steel market is based precisely on the rapid development of techniques which improve system operational flexibility and reduce costs"[(25)]. The process of differentiation is also outlined at several levels: not only between the iron and steel industries in the older industrialized countries and the industries in the developing countries, but at the same time even within the group formed by the industrialized countries, between the main group led in particular by the integrated Japanese and German steel interests[(26)] and the others which follow at various distances.

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(24) The question of the difficulties resulting from the evaluation in terms of raw steel is put forward in EUROFER, IISI, Mr. Signora, etc.

(25) City Bank Bulletin - June 1980, p. 14.

(26) Whence the reticence of German steel interests in regard to the quotas established by the EEC (Davignon) to the extent that they feel that they have nothing to fear from competition either with the Americans or the Japanes, or with the Third World. Cf. "Steel quotas rattle the EEC" in Business Week, 10 November 1980.

21. The impact of this evolution will exert itself directly on iron and steel production and the economy of the industry, since iron and steel installations will only operate to specification under satisfactory conditions of cost, price and cash-flow when engaged in high-quality mass production.

The results of the Japanese groups which, despite their low market share (approximately 70%) have increased their profit during the financial year 1979-1980, fit into this perspective. Whereas in many developing countries the iron and steel interests have to support the cumulative weight of high investment costs, low market shares and an average quality level of the product.

22. It will also be exerted indirectly on the possibilities and conditions for the production of capital goods, in particular goods intended for expanding outlets of the energy systems (new oil, schists, coal, renewable energies), in transport systems, etc. The manufacture of these goods will require iron and steel products offering an excellent quality/price ratio or quality/weight ratio, or again improved machining properties[27]. In the same way that it is impossible to produce tubes for oil and gas pipelines if the sheet used does not meet the API standards[28] there will be a risk in the future that it will become difficult, in the developing countries, to progress in the production of equipment goods without passing through the importing of highly sophisticated iron and steel products, the use of which will then tend to become established as a standard. However this also shows the point at which iron and steel production is linked to converting and to the manufacture of machinery and equipment. It can be understood, under these circumstances, that

(27) Steels of the type at the present time developed by CREUSOT-LOIRE permitting machining economies (15 to 35%) and increases in cutting speeds (50% and more); a category of steel already produced and used by the Japanese.

(28) American Petroleum Institute.

certain producers of high-performance steels (better machinability, for example) prefer initially not to export their new production so as to reserve them for improving the cost price and competitiveness of their own engineering production on external markets.

23. This leads us to emphasize the following:

- the impossibility of envisaging any development in the iron and steel industry without questioning its links (both present and future) with the engineering industry and in particular with the capital goods industry by posing the question: "What iron and steel industry for which engineering industry ?". In this respect a comparison will be made between the world study on the steel industry and parallel work carried out by UNIDO on the development of the capital goods industry in the developing countries[29];

- the need to take into account the massive preponderance of the industrialized countries in regard to the manufacture (and trading) in capital goods and, as a consequence, in regard to defining the standards which control the use and manufacture of these goods;

- the need to identify the possibilities for developing local manufacture of capital goods progressively linked with local iron and steel production. Is it possible to progress along this line and how, so as to avoid limiting oneself to the production of products depending on obsolete techniques but, on the contrary, to master progressively the advanced techniques ? How does one operate on the possibilities of alternatives offered by the centrally planned economy countries, etc. ?

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(29) Cf. Documents prepared by UNIDO/IS for the Warsaw meeting of November 1980 (ID/WG.324/4) and for the Brussels consultation (September 1981).

24. These questions raise further questions concerning the efficiency of the training programmes capable of leading to the progressive mastery of techniques and of the iron and steel industrial system. Traditionally technical mastery in iron and steel production passes through three major stages: firstly long products, then flat products, finally high grade and special steels; firstly the production of ordinary steels in mass, then the production of high grade and special steels in small quantities. Arrival at maturity of the available routes implies already that the third stage be telescoped with the two previous stages and that there is no longer - and this is at least a risk - any mass production unless this production is not also of high quality[30]. How, in this case, can one shorten the delays and open up the possibilities for new iron and steel interests to raise themselves rapidly to this level of mastery ? Does this reinforce the necessity to pass through the mastery of installations of small or medium size before mastering installations of large size ? In any case this underlines the extreme importance of circulating information to ensure the integration of working teams, together with the matching of iron and steel productions to the needs of its downstream users.

25. The success of new iron and steel industries therefore implies:

- that they immediately aim very high: a very high technical level as well as confirmed capability in systems management;
- that they immediately pay attention to adapting and appropriating techniques, that is to say research and development.

(30) Which introduces a new graduation into technological complexity.

E. RESEARCH AND DEVELOPMENT : AN ESSENTIAL REQUIREMENT

26. The report of the Office of Technology Assessment[31] strongly attributed the low dynamism of the American iron and steel industry to the insufficient depth of research and development within the industry. On the other hand, it is not surprising that the Japanese iron and steel industry has overtaken most of its competitors in this field, especially as, like the German industry it is increasing its efforts, while funds available for R & D remain the same as in the USA and decrease in France.

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(31) Op. cit.

Table 3

Sums devoted to research, 1978				
	Japan	USA	FRG	France
Percentage of turnover devoted to research	1.4	0.7	0.7	0.4[32]
Sums devoted to research (US$m)	450	210	90	28
Index: Japan = 100	100	46	20	6

Source: IRSID Documentation.

27. The stake of R & D in the iron and steel industry is of importance, because it is not so much the devoting of rare resources to systematic preparation for a radical technical breakthrough (of the LD process type), as to reduce dependance on others, to overcome delays, and to contribute to the operation of the steel industry under acceptable economic conditions.

In fact, one cannot over-emphasize the relationship between research and high quality in steel production. In this movement research tends to be based on quality control linked to the production of continuously improved products, and to give new impetus to the more basic knowledge and research relating to the chemical composition, physical structure and behaviour of steels which also govern this production. The production performance of a steel industry is, in fact, inseparable from the continuous preparation and adaption of techniques to local conditions.

This orientation is even more necessary when steel production involves the use of raw materials and local energy sources which do

(32) Of which 0.25% for IRSID and a little more than 0.15% for research carried out by steel companies on their own account.

not necessarily correspond with normal international standards. Thus, it seems very wrong that R & D is often treated as a "luxury product" in the steel industry.

28. In addition one must strongly emphasize the social, or rather socio-economic, dimension of research because there is a close relationship between research for performance, production quality, and improvements in working conditions. The latter are closely related with an improvement in a steelwork's performance, resulting in longer refractory life, a reduction in time devoted to the particularly arduous work of restoring refractory material, the satisfactory use of the continuous casting process, fewer surface faults allowing a reduction (and even deletion) of the various scarfing operations, etc.

29. Research is thus organized at the site, starting from the application of techniques and the pursuit of quality; research departments must be created, these constituting an intermediate link between production (where experience is accumulated) and more fundamental research of the university type (localized and not within a university). In any case, the rapid supply and free circulation of information are basic conditions for ensuring valid research, as well as the development of the collective application of proficiency and know-how.

The Japanese iron and steel industry offers a very good example of the close link which exists between production quality/performance, the development of work teams (JISHU KANRI) and collective know-how, the intense and free circulation of information and the importance of research and development.

30. Finally we should emphasize the character which is necessary for research not only for the most advanced iron and steel industries but also for the iron and steel industries in the developing countries:

a) The development of research capabilities is a condition of the vitality and of the production of every iron and steel industry which is already established. As is already well known to produce is to assimilate, to produce is to adapt and finally to invent. In this sense the expenditure devoted to research form part of the very life of industry.

b) A definite orientation of iron and steel research is, furthermore, the condition of entry into the iron and steel industry or of the greater mastery of this industry by numerous developing countries whether it involves:

- the better defining of the conditions of liability of small or very small sized units,
- the development of direct reduction processes (or modules) adapted to the smallest sizes,
- of the development of rolling mills for flat products (of the STECKEL-SENDZIMIR type) of smaller dimensions,
- of the development of single casting machines with a single line,
- of the development of modern equipment designed as a function of ease of maintenance, etc.,

and, more generally, of the adaptation of installations designed for an industrialized environment to the non-industrialized environments of the developing countries.

F. <u>SUMMARY</u>

31. The "Technology and research" dossier allows the following <u>hypotheses</u> to be advanced:

a) Apart from the direct reduction process, it does not seem possible to envisage a major technological breakthrough during the eighties, but accelerated perfection of the standard process supplemented by the "scrap-electric furnace" system.

b) Under the direct or indirect impact of the new energy data, the steel industry is "attracted" towards quality, not only the production of small quantities of special steels but the mass production of high-grade steels designed to satisfy the increasingly demanding requirements of consumers and converters.

c) The perfection of standard systems, and the trend towards quality, implies that priority should be accorded to research and development (and to the resources devoted to this end) in order to "maintain" quality.

d) The direct reduction process is the only true technological breakthrough, its development being largely governed by the existence of natural gas resources. An acceleration of oil research in developing countries makes it possible to assume that further countries will be capable of using this technique.

32. From these hypotheses on development the following problems arise:

a) These developments are likely to result in an accentuation of differentiations between:

- industries capable of achieving and maintaining quality and of linking steel production with engineering and other production systems.
- Northern iron and steel producers themselves and also between Third World iron and steel producers.

b) These developments pose the question of the validity of "catching up", conceived in the simple terms of quantity of crude steel.

c) They also pose the question of the most suitable training methods for providing know-how on a modern steel system (linked to downstream requirements), of channels and means of learning curves in developing countries.

d) The direct reduction process "breakthrough" using natural gas poses the question of participation by Third World countries interested in developing processes (large and also small) from the range of ores which can be used, etc.

33. The dossier allows the following objectives for international negotiations to be determined:

a) Developing countries are particularly interested in the direct reduction method using natural gas. It is in their interests that the widest possible use be made of this process. It is therefore in their interests that research be orientated in accordance with their problems and requirements. At the same time, they have assets in the way of hydrocarbons. This is a possible opening for negotiation:

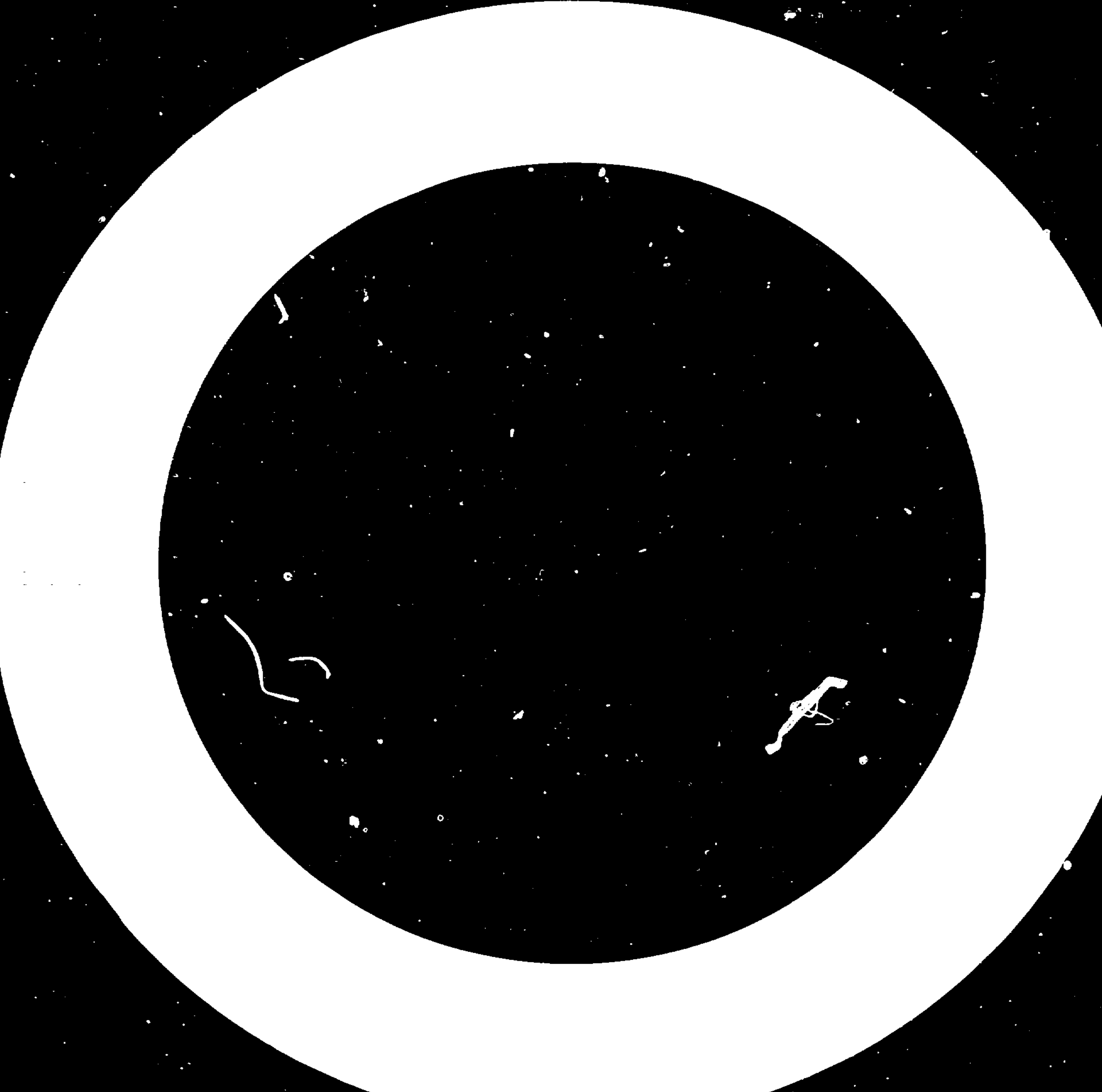
i) with the more advanced Southern countries in order to sustain the adaptation of processes and the promotion of R & D by means of regular financing;

ii) with the more advanced steel industries of Northern countries, using the energy asset in order to orientate research and modifications and to accelerate participation of the new Southern steel industries in the application of research.

b) The new African oil countries, the Ivory Coast, Cameroun, the Popular Republic of the Congo and Zaire, often have high-grade ores, and may become candidates for the installation of direct reduction plants. Without doubt their possible production in 1990 would not be much in world production terms, but it would not be negligible where the internal requirements of these countries are concerned. In liaison with the African representative bodies and within the framework of the Decade of African Industrialisation promoted by the General Assembly of the United Nations, a specific negotiation is to be organized to encourage the establishment and implementation of steel projects.

c) Research into new training methods for training human resources capable of mastering the quality of steel products, new technological processes and the administration of small plants implies considerable changes in international cooperation and technical assistance. These changes imply modifications on the part of the industrial countries where the content of technological transfers and training programmes are concerned. A discussion of the latter between the parties concerned is itself a subject of negotiation.

d) More generally the organization of research corresponding to the interests of a large number of developing countries could also retain the attention of equipment manufacturers and of engineering companies in the developing countries themselves. The research into the best conditions of viability of small-sized units is a promising field for negotiation.



DOSSIER V

LABOUR AND THE DEVELOPMENT OF HUMAN RESOURCES

1. Numerous works have already emphasized the amount of training and skill involved in extending the iron and steel industry in developing countries. It is accepted that 1,000 employees are required in a small plant and 15,000 to 20,000 employees in a medium-sized integrated plant at the present time. Such numbers are not easy to obtain in societies lacking in an industrial tradition. Thus, the absence or limited number of experienced personnel often seems to be an equally large or evey larger constraint than the non-availability of raw materials and energy, or financing difficulties.

A. GENERAL LEVEL AND SPECIFIC ABILITIES

2. In fact it is found that there is a correlation between the relative level of steel-making progress in developing countries and the general level of education (measured by the level of illiteracy, the proportion of qualifications, etc.). This correlation shows itself in the level of steel-making in the countries of Africa and the Middle East, where the overall level of education is the lowest, and the countries of Latin America and Eastern Asia which have had a generally high level of education for a long time.

3. The experience of the European mini-steel industries[1] confirms that the existence of a high general level of education and an old working tradition allows them to attain high productivity immediately, without having to call in traditional steel-workers. It is true that mini-steel industries are simple production units which are largely standardized, as against the complexity of medium-sized or large integrated plants. This is why it is continuously

(1) Brescia in North Italy. In this respect, see the experience of ALPA in the Paris region where workers were recruited with no previous steelworks experience.

emphasized that there is an iron and steel industry trade, or rather blast furnace, steel manufacturing and rolling trades, and that there are steel-making families where the trade is passed from father to son.

During the first quarter of the XIXth century a very large number of British steel engineering foremen and workers were employed in French steel-making plants(2): during the last decade it was more than 1,000 workers from Lorraine (out of a total of 6,000 to 7,000) who definitively structured the personnel at the new FOS plant in the South of France. In the developing countries the satisfactory operation of an iron and steel industry requires a tradition which does not exist and which has to be created. How can the creation of this tradition be accelerated, by what means and short cuts ? This is the problem, and it must be resolved whilst taking account of technical developments in the industry (See Dossier IV : Technology).

B. TECHNICAL DEVELOPMENTS, TRADES AND SKILLS

4. The steel industry is undergoing rapid technical developments involving, inter alia, continuous changes in manufacturing processes, the introduction of automation, and the need for quality, which implies stricter tolerances, greater control and accuracy of operations, etc.

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(2) In order to transmit the more advanced technical know-how of the British iron and steel industry. Cf. "Sidérurgie et croissance économique en France et en Grande Bretagne (1735 - 1913)" - Cahiers de l'Institut de Science Economiques Appliquées - February 1965.
See also Gilles' monumental "Histoire des Techniques" - Ed. La Pléiade, 1978.

Commentators[3] feel in general that these changes require the upgrading of a minority of technicians and personnel allocated to design, control and maintenance tasks, and the downgrading of the greater part of the personnel employed on standard semi-skilled worker jobs. Such changes would involve the disappearance of the steel industry "trade" or "trades".

5. In this respect several investigations would be necessary in order to evaluate, for example, the gap which exists (and which is widening) between job descriptions - which is the stake involved in the workers' struggle to defend a threatened status - and the actual change in techniques and positions[4]. Discussions on the renewal of collective agreements would probably be full of lessons on the direction of sociological changes under way as a result of changes in techniques.

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(3) Cf. the work of the Centre de Sociologie Urbaine (FREYSSENET) in France.

(4) In general, the names of trades and professions change in accordance with technical progress, but with a delay due to the braking action of statuses, pressures from parties involved and existing skills of social-professional groups. The influence of social-professional groups and specialized training creates a tendency to diversification due to the reciprocal causality of statuses on titles. Technical progress has an inverse tendency towards a reduction of titles. But the overall operative function of technical progress is strongest in the long term. Thus Radovan Ritcha and his associates in "Civilisation au Carrefour" (Ed. Anthropos, 1969) shows that the titles of trades in the US Department of Commerce dropped from several thousands to about three hundred.

Nevertheless, the content of titles is an approximate (and sometimes remote) reflection on the content and evolution of technical progress. Hence the difficulty in defining tasks which closely correspond with the evolution of functions and their scale under the influence of technical progress. See P.F. Gonod: Pour une planification conjointe de l'éducation et de la technologie - Institut International de planification et de l'éducation - UNESCO - 1979.

6. Nevertheless the excessive and random nature of theories must be emphasized. Based on findings relating to the weakening of the old professions, these theories conclude that there is a general downgrading without adequately questioning the appearance of new skills. Numerous practitioners in the iron and steel industry insist, however, on the absolute need for "responsible workers" to permit successful automation, or the close relationship between high quality products (in the steelworks and rolling mill) and the accuracy of coordinated worker operations. 60% of the economy in energy achieved by the Japanese Nippon Steel Company between 1974 and 1978 was due to improvements in operational control, that is to say operations carried out by the labour force.

7. Recent work has drawn attention to the poor operational nature of certain concepts, long regarded as a measure of the influence of technology on work. In particular, traditional qualification data is more reliable for identifying "downgrading" and "upgrading" processes resulting from technological changes for numerous reasons, not least of which is the uncertainty of the concept.

In relationships between technology and work, the latter (i.e. employment) is often considered as a passive variable[5] in the same way as technological decisions are considered as preliminaries, work being modified accordingly. The concern - or curiosity - shown in respect of technologies linked with the various forms of automated production are indicative of the "waiting" attitude regarding the effects of technical changes. It is asked up to what point automation will change work, if not society.

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(5) Regarding the recognition of worker know-how in production techniques see D. Mothe "L'autogestion goutte à goutte", Ed. Le Centurion, Paris, 1980.

In fact, research carried out on the strategies used in large groups raises doubts as to the strictly passive nature of work, even when brought back in essence to its dimension of employment.

In addition, through their own vicissitudes, the experiences of technological transfer involve adapting the technologies of industrialized countries to the nature of the work force in countries accepting the transfer.

All of this assumes that the relationships between technology and work are mutual.

8. In addition, the Japanese iron and steel industry accords considerable importance to the collective know-how of workers organized systematically into work groups (JISHU KANRI)(6). Apart from the specialities of a given national context other examples suggest(7) that the cohesion as well as competence of work "collectives" are an essential basis for technical-economic progress, and that they must be taken into account when establishing training methods and when organizing training.

After all, work is also a collective reality: this fact is often ignored.

It seems that there are not only work groups, but an actual group skill, the content of which varies with the type of technology applied. Thus there are very complex forms of group skills in process industries where operation is based on shifts.

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(6) "Voluntary group activities in Japanese Steel Industry", Nippon Steel News - September 1979.

(7) See communication from M. Liassine (then Chairman and Managing Director of the Algerian National Steel Company) to the Dijon Conference on the Transfer of Technology - September/October 1976.

9. Contradictory trends give rise to opposing interpretations. On the one hand, it may be asked whether new technologies have a tendency to dissociate old work groups and to eliminate them or their skills. In this sense, new technologies will fall into the long history of work division gradually applied to all sectors of the economy.

On the other hand it is also possible that the increasing automation of numerous production processes will result in the emergence of new groups where semiology falls into step with the "tricks of the trade" and the transmission of know-how.

10. Finally, it will be noted that several advanced techniques currently being applied or perfected not only involve technical changes but an improvement in working conditions. This is the case of the following in particular:

- an improvement in the quality of refractory products and better control of thermal shock, thus permitting a reduction in the time spent in very laborious lining operations;
- the development of continuous casting, resulting in an economy in costly and laborious scarfing operations;
- an improvement in productivity linked to planning workshop facilities and environment (temperature, dust, humidity, etc.).

11. It appears that the increasing requirement for quality and accuracy is not compatible with difficult working conditions, cannot be achieved by means of a strict "industrial discipline" alone, and that serious consideration must therefore be given to the principle, hardly compatible with "Taylorism", which engenders the downgrading process, i.e. the ever more pressing demand for accuracy and quality. It is probable that during the eighties the

problems of collective promotion of labour and rapid improvements in working and living conditions (housing and transportation) will tend to be considered as a decisive technical-economic part of industry, and no longer as a simple so-called "social" secondary component.

C. <u>TECHNICAL LEVEL AND TRAINING CURVE</u>

12. The questions of skills and training arise in different terms depending on the country and the level of experience already acquired in the iron and steel industry. Certain countries (such as India) have steel-making experience which goes back to the beginning of the century and which has constantly diversified. Others are gaining experience in controlling their first integrated plant; finally, the majority have only a rolling mill, a small semi-integrated plant or nothing at all.

13. Countries interested in projects investigated for 1990 are distributed in the following three categories:

Table 1

	Level 1 (nothing, or merely rolling mill or small semi-integrated plant)	Level 2 (First experience with integrated plant, generally recent)	Level 3 (Advanced and diversified experience)
Latin America			
Argentina			X
Brazil			X A*
Mexico			X
Venezuela		X	
Chile			
Peru		X	
Colombia		X	
Ecuador	X		
Central American States (6)	X X X X X X		
Cuba		X	
Paraguay	X		
Uruguay	X		
Trinidad	X		
Sub-total	10	4	3
Middle East			
North Africa			
Morocco	X		
Algeria		X	
Tunisia		X	
Libya	X		
Egypt		X	
Syria	X		
Iraq	X		
Jordan	X		
Lebanon	X		
Saudi Arabia	X		
Qatar	X		
Bahrain	X		
Abu Dhabi	X		
(cont'd)			

* X A = particularly advanced

Table 1 (cont'd)

	Level 1 (nothing, or merely rolling mill or small semi-integrated plant)	Level 2 (First experience with integrated plant, generally recent)	Level 3 (Advanced and diversified experience)
Oman	X		
Iran		X	
Sub-total	11	4	0
Africa, south of Sahara			
Mauritania	X		
Senegal	X		
Togo	X		
Ghana	X		
Ivory Coast	X		
Nigeria	X		
Central African Republic			
Cameroun, United Rep. of	X		
Zaire	X		
Angola	X		
Zimbabwe		X	
Zambia	X		
Mozambique	X		
Tanzania, United Rep. of	X		
Kenya	X		
Uganda	X		
Sub-total	14	1	0
Asia			
China			X A
Afghanistan	X		
Pakistan	X		
India			X A
Sri Lanka	X		

(cont'd)

Table 1 (cont'd)

	Level 1 (nothing, or merely rolling mill or small semi-integrated plant)	Level 2 (First experience with integrated plant, generally recent)	Level 3 (Advanced and diversified experience)
Burma	X		
Bangladesh	X		
Malaysia		X	
Singapore		X	
Indonesia		X	
Thailand		X	
Philippines		X	
Vietnam		X	
Popular and Democratic Rep. of Korea			X A
Rep. of Korea			X
Other Asian countries			X
Sub-total	5	6	5

14. The distribution of countries by regions and level is summarized as follows:

Table 2

	Level 1	Level 2	Level 3
Latin America	10	5	3
Middle East - N. Africa	11	4	0
Africa, south of Sahara	14	1	0
Asia	5	6	5
TOTAL	40	16	8

Whilst Latin America and Asia have already accumulated long and complex experience, in certain cases, the Middle East and Africa are still taking their first steps ....

15. This diversity of situations introduces the problem of training adapted to each level, in order to permit progress in stages.

Special interest is attached to the 41 developing countries which are starting an iron and steel industry, or which have very limited experience, especially as the steel-making experience of industrial countries is mainly in respect of large integrated plants, the development of mini-steel industries being a recent localised development.

16. It must be added that technological development in the iron and steel industry in general implies a constant revision of training methods. Thus a recent survey concluded that "changing technology makes basic changes in the entire craft training system even more urgent".[(8)]

In this respect, it seems that the frequency of studies and research has not been compatible with the increasing requirement in this field. Without considering this opinion as proven, it may be noted that out of a list of 46 major surveys[(9)] covering training problems in the steel industry, 33 were carried out between 1964 and 1970, and only 13 during the seventies: 22 surveys were carried out in the United Kingdom but only 5 in developing countries, all before 1970.

This is why the initiative of the Iron and Steel Committee of the International Labour Organization is particularly wise to incorporate in the agenda of its October 1981 meeting the question of the impact that the establishment of iron and steel industries in the developing countries will have on training and the development of skills.

(8) "Changing maintenance requirements in the Iron and Steel Industry", A Report of a Research study carried out by the Industrial Training Service on behalf of the Iron and Steel Industry Training Board, London, September, 1979.

(9) Bibliography provided by the International Labour Organization, with UNIDO'S grateful acknowledgement.

D. PROBLEMS OF MANAGEMENT

17. The operation of an iron and steel industry places it in a close, voluminous and dynamic relationship with its suppliers upstream: suppliers of ore, energy, limestone or refractory products whose dispatch involves strict programming, rejecting out-of-stock situations, and its downstream customers, the purchasers of rolled products whose needs and requirements become increasingly specific, implying a maximum of continuous collaboration and joint research.

18. Under these conditions the effective operation of a steel works depends on the degree of control of a complex industrial system which must, in order to assert itself, contribute to shaping and reshaping its environment. In this respect, it can be said that the importance of the steel industry arises as much from what it "promotes as from what it produces"(10). This applies to the Indian steel manufacturers' successful undertaking in constructing the second stage of the BOKARO plant whose "Indianisation" has required the use of some 500 Indian sub-contractors of which the majority are participating for the first time in this type of operation(11).

19. The training of management in the steel industry cannot neglect these wider aspects. Would it be possible to justify such mobilization of personnel and technicians (in number and in qualification) for a simple steel plant, if they are not effectively prepared in accordance with the driving (polarizing) role which the steel industry is called upon to play with respect to its economic environment, and systematically trained in this respect? This requirement, linked with the need for integrated inter-sectoral planning, indicates the required content of training programmes for executive personnel in the developing countries.

(10) Communication from M. Liassine, former General Manager of the Société Nationale de Sidérurgie Algérienne, to the Congress of Arab Economists, October 1970.

(11) Cf. UNCTAD TD/B/C.6/27, 1978 : "Achat de biens d'équipement et de technologie dans le secteur sidérurgique".

E. THE NEED FOR NEW APPROACHES

20. Everyone knows today, sometimes as a result of costly experience, that a satisfactory training system is a basic condition for the efficient operation of a new iron and steel industry. Delays in achieving full production or erratic operation are evidence of the generally inadequate mastery, up to the present time, of the organization of training. Neither are the users able to master completely the contents of their training requirements, nor do the training staff have an exact definition of the knowledge which it is necessary for them to impart. The market for training for the iron and steel industry has developed very rapidly, but at the price of false starts which have not yet been sorted out. Many questions still remain:

- is it necessary to train all the personnel from the beginning, or even progressively, on the site as the project takes shape ?
- is it necessary to train technicians for the iron and steel industry in the under-developed countries according to the standards and uses of the iron and steel industries of the industrialized countries ? To what extent is it necessary to revise and develop training systems adapted to specific conditions ?
- how are the results of the training systems which have been developed to be evaluated, and hence how is the pertinence of the methods used to be judged ?
- how is storage of the training actions undertaken to be effected, both on the side of the users and also on the side of those involved in the training ?

It would seem that questions are just as numerous in regard to the organization of Technical Assistance: is it necessary to create high-level technical assistance ? Or is it better to provide "on the site" technical assistance, based on senior technicians and specialists ? Should intensive assistance, more limited in duration, be preferred to a lower level of assistance over a longer period ?

21. In the field of training and technical assistance everyone, including experienced iron and steel men, have much to learn, the more so since the world industry taken overall is entering a phase of change which is likely to pose questions concerning those forms of management and the organization of work on which the architecture of training systems is modelled at the present time.

For the impact of quality requirements is not limited to the implementation of a quality control and inspection department, but has repercussions on the whole of the industrial organization at every level and in each of its components. For this reason "quality" tends to involve not quality control at a relatively junior level but one of the directors at the summit of the organization. Furthermore the impact of this imperative of quality is reflected by a renewed working organization parting company with the demarkation of tasks and tending towards what the Japanese call the JISHU KANRI or "self-management"(12) groups. The American iron and steel industry is in the process of opening up this route opened up by the Japanese, in particular within the framework of a new agreement negotiated with the trades unions in the sector(13). It is probable that it will be imitated by others. At all events the construction of coherent training systems should take into account this new situation so as to allow, by utilizing all the possibilities opened up by training to the iron

(12) According to the translation given by Japan Economic Journal

(13) Cf. A try at steel mill harmony - Business Week dated 29 June 1981.

and steel industries in the developing countries, the possibility of becoming modern and integrated industries in this major movement towards quality.

E. SUMMARY

22. The "Labour and the development of human resources" dossier allows the following hypotheses to be put forward:

a) An increase in the general education and technical level is of increasing importance in developing an industry moving towards quality (understanding of processes, knowledge of physical and chemical structure of materials, etc.).

b) The rapid development of the industry results in a downgrading/upgrading process which tends to replace traditional trades in the industry. New skills appear which seem to start a reversal of trends: it is not just a question of modifying a work force in accordance with the relentless development of techniques, but also - in order to be effective - of adapting techniques to the reality of the work force.

c) Modern iron and steel industries - in particular the Japanese experience, amongst others - bring to light the collective importance of work and know-how, as well as the social dimensions of technical development and their reciprocal conditioning.

23. The development of the hypotheses allows the following problems to be identified:

Experience shows that the collective aspects of the knowledge of workers are not without effect on the operation of iron and steel units; individual training of workers is not necessary, and has been shown to be inadequate to guarantee a steady rise to full production.

a) The "collective worker" does not appear to be of lesser importance in developing countries; it seems that it is more at this level than in the training of individual workers that the main productivity problems of undertakings are involved.

b) The questioning of an accelerated process of task division (Taylorism) does not only fall into a perspective of "new growth" and the emergence of new values in work, but under modern steel-making conditions seems to meet the need for efficiency.

c) The "polarizing" nature of the iron and steel industry underlines the importance of the management function in controlling a complex industrial system. This control probably conditions the success of the industry as much as the technician's competence.

d) The uneven nature of the steel-making situation and the experiences of developing countries requires: (i) a better knowledge of training curves; (ii) a critical evaluation of the possibilities of taking short-cuts; (iii) the consequent preparation of <u>detailed training programmes</u> which take account of new process technologies (see Dossier IV : Technology) and new quality requirements.

e) Further research is necessary in order to re-evaluate labour training programmes, particularly under the conditions obtaining in the developing countries. An examination of the problems encountered when implementing investment projects and during the operating stage (see Dossier VI) also shows the need to improve training in respect of technological transfers.

Research should be undertaken to devise better time scheduling of training: from before or during the period of erection ? It also needs to consider its best location: on the site or off the site ?

Such research should be based on as systematic an undertaking as possible in the evaluation and storage of the training activities already undertaken or in hand.

Finally programmes should be developed for training managers and higher level executives, taking into account not only the need to master an iron and steel unit but also to consider the impact of this unit on its environment.

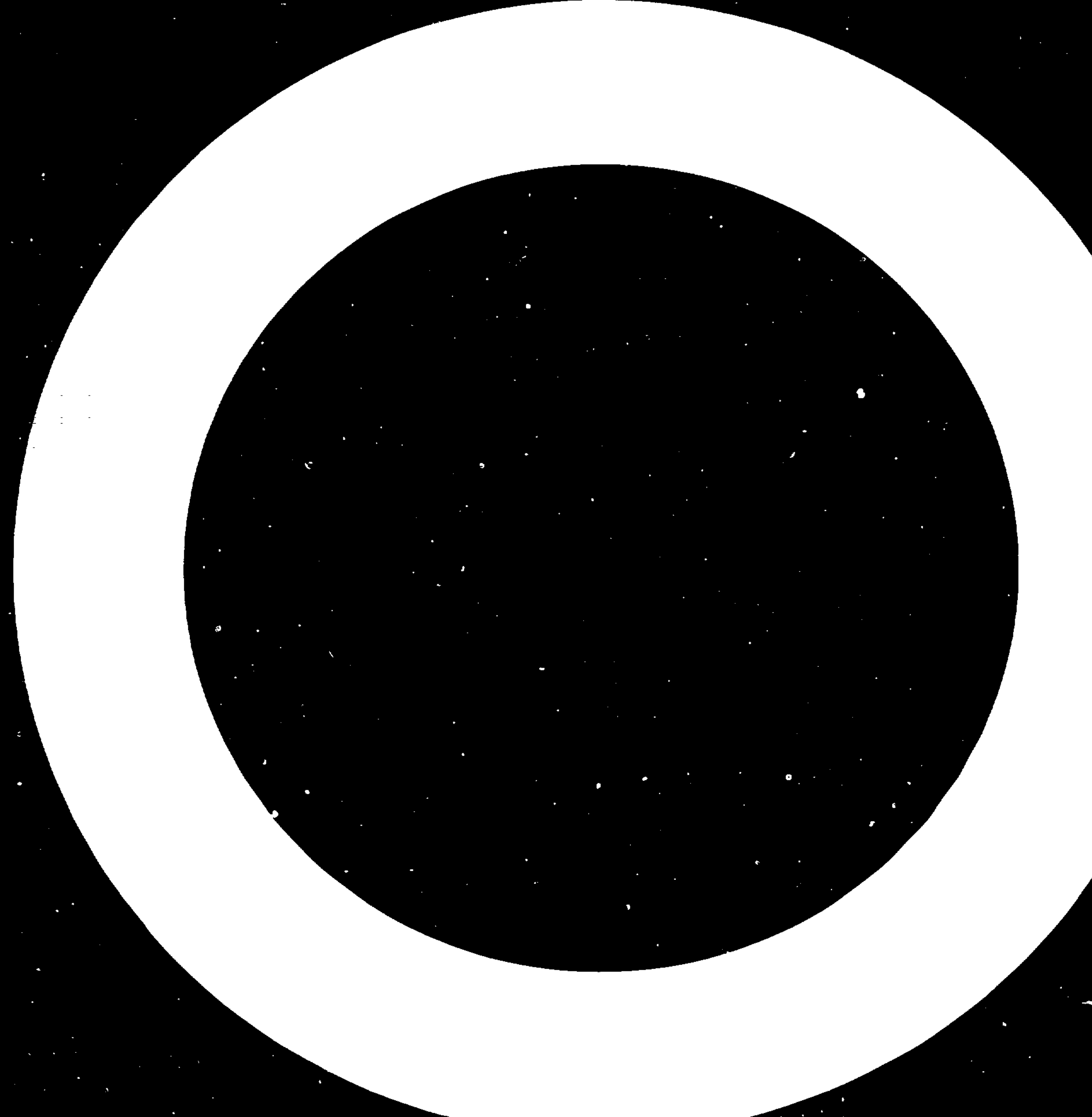
22. In order to help in resolving training problems, the following objects of negotiation could be explored :

a) Aid by way of training to the 41 countries with limited experience which propose to create or develop an iron and steel industry could be the subject of a special investigation to develop a specific programme.

b) Depending on the nature of projects, and in particular the choice of technological route, the experience acquired by certain countries in the "South" in the field of personnel training could be negotiated.

c) An exchange of experiences between steel industry administrators and those responsible for the industrialization of developing countries should make it possible to redefine the training profiles, thus permitting the steel industry to play its part in full in a developing area.

d) The reorientation of training programmes should be carried out as a function of the latest technological data from industry, a discussion of relationships between the development of techniques and the work force, the collective nature of work and know-how, its effects on methods of transfer and the uncertainty which currently exists regarding upgrading/downgrading. In this respect, the preparation of these new programmes concerns not only the developing countries, but also the industrialized countries. This is why cooperation in this field is of joint interest.



DOSSIER VI

THE DESIGN AND IMPLEMENTATION OF PROJECTS AND THE COMMISSIONING OF NEW PLANTS

1. To design, implement, produce and control the manufacturing processes and administration of an iron and steel plant are obligatory stages of any project.

All of the variables covered in the various reports come into play throughout these stages: financing and costs, markets, prices and marketing, raw materials and energy, technology and production scales, the necessary infrastructures and the human resources. These variables are associated in combinations and proportions which vary throughout the stages.

2. In this dossier we have tried to avoid repeating what has been dealt with elsewhere, particularly financing, a problem so important that it is covered by a separate dossier.

This dossier has therefore been limited to problems which have not been analysed elsewhere, or which require special explanation.

It will therefore mainly cover aspects of the design and implementation stage: the necessary infrastructures, the methods of implementation and the actors involved. The same applies to the production and industrial management stage.

A. PROBLEMS DURING THE DESIGN AND IMPLEMENTATION STAGE

Aspects of design

3. In general the ability to design projects is lacking in the developing countries. The same applies to the feasibility study and project preparation stage. The domination of complex interdependences is currently the privilege of engineering companies in industrial countries. Local participation in developing countries is generally limited to the detailed engineering (according to the terminology used in Latin America). Exceptionally, Third World engineering companies may take on a complex project from its conception to implementation and entry into full production (e.g. the Dastur Company in India, the Bufete Company in Mexico, etc.).

The list of 1990 projects (see Dossier I, table 12) reveals the existing imbalances and the need which the majority of developing countries have of foreign assistance.

4. The first problem arising is the danger of losing control of essential choices, this faculty being the mainstay of a policy of self-reliance(1).

Engineering firms are generally linked or integrated with the owners of technological processes, or are themselves the owners. Where information is incomplete, the name of the engineering firm is, ipso facto, that of the technological process. There is really no choice in the matter.

In order to make a real choice, it is necessary to reverse the problem: to provide at least for a preliminary evaluation of technologies, and then to select an engineering firm. This implies: structured technical-economic-marketing information and multiple-criteria methods of evaluating technologies involved in decision-making(2).

5. The options are interdependent: choice of partners, financing, legal structures, destination of markets, and the choice of equipment suppliers and technologies.

Within these interdependences, financing appears to be the strategic variable. The latitude available for decision-making by developing countries is limited in the existing economic order (see Dossier VII: Financing).

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(1) See UNIDO study "The Technological Self-Reliance of Developing Countries: towards Operational Strategies", UNIDO/ICIS.133, 15 November 1979.

(2) See P.F. Gonod: "Matériaux pour de nouvelles politiques du transfert technologique" - Revue Tiers Monde No. 65 - January/March 1976, and Le Nouvel Ordre Economique et les Projets Industriels - UNIDO, ID/WG.237/10, 16 November 1976.

The constraint of the necessary infrastructures

6. Steel-making is a "development pole"(3) not only because of the physical and economic relationships which it involves, upstream and downstream, but also because of the infrastructure which it requires, and on which its existence and efficiency depend.

This is why a steel-making project cannot be considered without its supporting operations in the corresponding industrial fabric(4). Often neglected during the design stage, infrastructural problems lead to waste of human energy and financial losses later on during the operating stage.

7. The magnitude of the problems to be resolved is proportional to the degree of underdevelopment. The following non-exhaustive list shows the main requirements of an infrastructure: harbour, railway and road systems, supply systems, anti-pollution treatment workshops, the adaptation of mining needs to the steel project requirements, a telecommunications system, the necessary materials storage facilities, spares and finished products, the installation of maintenance workshops, and finally steel distribution centres. To these must be added the importance of human and social infrastructures, without which the stability of personnel would be illusory.

8. Transportation and the cost of transport play a decisive role in the choice of locations, to the extent that the volume of products handled by an integrated steelworks is equal to approximately four times the production volume. The cost of maritime transport has dropped in the most spectacular fashion during the last twenty years. Thus, between 1957 and 1970, the cost of delivering a tonne of iron ore to Japan dropped from US$ 20.0 to US$ 10.29, and the cost of

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(3) See F. Perroux: Note sur la notion de "Pôle de croissance" - Economie appliquée No. 8, 1953; L'effet d'entraînement: de l'analyse au repérage quantitif - Economie appliquée, 1973; and Albert O. Hirschman "The Strategy of Economic Development", Yale University Press, 1966.

(4) See G. Neyret: Réflexions sur la methode de projeter, construire, constituer l'équipe de production, organiser et mettre en route une usine sidérurgique au Tiers Monde - June 1976.

delivering a tonne of coking coal dropped from US$ 26.23 to US$ 14.40. Thus, maritime transportation is used (and will be used) in preference to continental transportation which is more costly and more difficult to administer in many developing countries. One may question the probable trend of transport costs in the future in order to know whether it will continue to benefit coastal locations.

Whatever the trend during the decade, developing countries will find themselves confronted with the dual requirements of developing their harbour installations and their road and rail systems.

In the first place, it is necessary to provide a solution for harbour installations used for imports. Investment costs for these structures appear to be considerable(5), but the economies achieved in operating costs are also considerable.

In the second place, these different tonnages, packed and delivered in different ways, require appropriate installations and means of transport, but also organization to prevent hold-ups, double handling, unsuitable storage and the halting of production. Unfortunately, these problems generally remain underestimated for economy reasons or as a result of negligence. In fact, there is a considerable temptation to believe that steel industry investment may adapt itself (subject to certain work) to the existing environment, while in fact the latter must be modified accordingly.

Finally, decisions to be taken concerning inland transport must not relate to the steel industry alone. The pulling effects of the latter must combine, for example, with other objectives, for example to develop a region or to reduce inequalities in regional growth. These criteria must be taken into account from the moment a project is conceived.

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(5) Dastur Engineering International, GmbH, study: "Report on World Wide Study on the Iron and Steel Industry - Contribution to the World Iron and Steel Scenarios up to 1990, October 1980.

9. The constitution of supply systems is another infrastructural constraint. The supply requirements (water, gas, electricity, etc.) of a steel plant are so important that they often require special investments. Problems encountered by developing countries in this field relate in the first instance to an insufficiency of available resources (in particular water), the timely installation of supply systems or production facilities, the reliability of supplies and provision of means of storage or production in case main systems fail.

When operators responsible for implementing the above conditions belong to different organizations, problems of coordination and planning between these bodies are very restrictive.

Telecommunications systems

10. A steel plant requires national and international communications (authorities, supplies, customers, etc.) and communication with security and health organizations (civil protection, hospitals, etc.). This implies interconnection with the telecommunication system in different forms: telephone, telex, post, etc. Under-development and the location of the steel industry create communication problems which may interrupt normal plant operations.

Storage and maintenance installations

11. The constraints of "continuous" operation assume the construction of storage and maintenance facilities suitable for solving the most diverse storage or maintenance problems. This applies to mining supplies, where buffer stocks must alleviate the impact of failures, and to finished products. The absence of such facilities in the "collective industrial fabric" leads to their creation when a plant is built. Since the possibility of sub-contracting is generally very low, the steel industry itself constructs and administers these facilities. The construction of

repair and maintenance workshops with a large variety of machines must be envisaged in developing countries. Frequently, the price to be paid is excess installed power, because this guarantees the plant against production risks and constitutes a centre of assistance for other industrial operations within the national environment. In addition, a policy of equipment standardization ensures that a large number of operational problems are resolved.

Distribution installations

12. The design of iron and steel plants in developing countries must take account of the product marketing policy. A multitude of small urgent orders implies the need for stock production in order to augment production runs. In addition, experience shows that the establishment of a product distribution system under the responsibility of the producer results in the creation and development of a solvent demand.

Social and cultural infrastructures

13. The insufficiency of so-called "social" infrastructures is reflected in a negative impact on the morale and productivity of workers: an absence of housing, inadequate transport, absence or inadequacy of collective equipment which contribute to a minimum "quality of life". It turns out that these "social" infrastructures have an economic impact of considerable importance, and that it is therefore rational to consider them as such from the start without waiting for their absence or inadequacy to bring in all the consequent braking and blocking effects.

14. Infrastructure constraints must be taken into consideration. The functions of management must therefore include them, their object being not only control of a strictly demarcated industrial plant, but an industrial system with a supplementary integrating and polarizing vocation.

Methods of implementation

15. Developing countries must face up to the various types of difficulties in implementing their industrial projects, for example the selection of the method of implementation, the elimination of obstacles to the participation of national operators, coordinating constraints between designers, suppliers and constructors, inspection difficulties, the coherence of planning departments in applying organizational work to the project work, local administrative delays and, finally, the influence of the method of implementation on the success of technological transfer.

In order to understand the nature of the problems encountered in developing countries it is necessary to identify the main parties involved in the implementation, and the content of their tasks.

16. The actors involved in implementation are the following: a) the designer; b) the supplier; c) the contractor; d) the holder of industrial know-how; and e) the owner.

17. The designer is defined, in general and process engineering, as one who may exert the following responsibilities: general design, definition of process equipment, preparation of layout plans, preparation of general equipment specifications, administration of building and commissioning, supplies, inspection and testing, coordination, planning, budgeting, preparation for commissioning, and final conformity checks. On the other hand, the detailed engineering department is responsible for working drawings, detailed drawings and installation drawings in the following general disciplines: civil engineering and earthworks, steel structures, electrical, instrumentation, pipework, vessels and boilerwork. It is usual to find that all of the above mentioned tasks are carried out within an organization which combines both functions.

18. The supplier. In fact, there are several types of suppliers corresponding to the different types of supplies: ex-catalogue, normal items, and special supplies.

Thus, the responsibility of suppliers is very different, depending on the equipment delivered. For normal items, deliveries are made from stock. For items in accordance with a standard, manufacturing times are often specified, and finally for process equipment, special manufacture is required.

Deliveries, grades, prices and after-sales service vary in accordance with the suppliers and the cyclic tendency. Competition is generally very heavy, and financing thus becomes a commercial obligation.

19. The Contractor is responsible for construction and erection of equipment (apart from the process), and carries out work in accordance with the detailed drawings. He is responsible for costs, deliveries and quality of the work. He incurs considerable financial risks, and his technical, human, material and financial precautions must be in relation to the volume, difficulties and delivery dates involved in work entrusted to him.

20. The holder of industrial know-how is not often explicitly specified among the actors, because the designer and supplier use their ability and industrial experience to produce their own designs and carry out their own work. However, it is necessary to emphasize his importance because in the majority of cases developing countries do not have industrial know-how and must therefore use his services. Since he has skilled labour, a thorough knowledge of the technology, production and maintenance routines, a capacity for adaptation and, finally, highly developed administrative facilities, he is able to offer considerable services to the owner acquiring the technology.

21. Owner. Whilst control of construction is often sub-contracted, because it is closely linked in practice to the design function, the ownership function is difficult to sub-contract because it covers interests and fields which are the client's responsibility. In fact, the role of the latter is to ensure that all the partners implement his objectives. In this respect, he must ensure :

- compliance with quality, deliveries and costs during the design and construction stage;
- results which meet objectives in respect of technological transfer, production, maintenance, and integration of local partners;
- that the services of local administrations and authorities are provided in good time, with the facilities required for operation of the steel manufacturing project.

The various industrial agreement formulae

22. The main actors are linked by financiers within the framework of industrial agreements. These agreements are made in accordance with the various formulae summarized in Table 1.

These formulae include a variable number of functions to be fulfilled, and which are assumed by one or more firms.

23. The industrial agreements(6)(7) are a concrete expression of the cooperation required by the two partners and of the force relationships between them(8).

Thus, the weaker a partner the more he will need the "packet" of goods and services transferred. Paradoxically, a "strong" partner may also import this "packet" without inhibition - in the form of "turnkey" plant - because he will have sufficient technology and administrative assimilating capability.

(6) For a classification of industrial agreements, see S.N. Behrman: Decision criteria for foreign investment in Latin America, Council of the Americas, 1974.

(7) For a detailed analysis of industrial agreements regarding exportation on complex industrial plants, see Euro-economics: Export markets for major industrial complexes - present position and future prospects - Eurofinance - 1978.

(8) For force relationships in industrial agreements on technology, see P.F. Gonod: Conflit-coopération dans le transfert technologique - Mondes en Développement No. 14, 1976.

TABLE I

Various types of industrial agreements
(between non-affiliated undertakings)

Functions \ Formula	"Break-down" formula	Design and supply formula	"Turnkey" formula	"Product in hand" formula	"Market in hand" formula
Design	X	X	X	X	X
Construction	X	X	X	X	X
Supplies	X	X	X	X	X
Transfer of production techniques				X	X
Transfer of administrative techniques				If required, but limited scope	If required, but limited scope
Market			Compensation agreement if required X	Compensation agreement if required X	X
Financing	X	X	Suppliers' credit/ purchasers' credits	Suppliers' credit/ purchasers' credits	Suppliers' credit/ purchasers' credits
Raw materials			Compensation agreement if required	Compensation agreement if required	

As other countries progress, particularly the more advanced countries of the Third World - the semi-industrialized countries - they tend to select goods and services carefully in order to limit costs, improve quality control, obtain their know-how, and also incorporate capital goods, services and local engineering (for example, Brazil, India and the policy tried under the Andean Pact). In such cases, the tendency is in favour of precisely defined "break down" formula. They provide better interdependence modes for developing countries.

24. Industrial agreement formulae adjust themselves to the types of owner liable to assume risks associated with the contractual formula considered(9):

Table 2

Construction formula	Type of contractor	The most frequently used formula in typical relationships:
Conventional steel-making Breakdown formula	engineering	between industrial countries
Design and supply formula	supplier	between western and a socialist economy industrial countries.
Formulae { turnkey product in hand market in hand	assembler	between industrial and developing countries
Mini-plants	assembler	between western industrial and developing countries
Direct reduction process	process owner	between western industrial and developing countries

(9) In accordance with study by A. Benbouali: Long-term Contractual Arrangements for the setting up of capital goods in the Iron and Steel Industry - UNIDO ID/WG. 324/6. - September 1980.

25. Thus, construction functions are unevenly controlled, this inequality being the expression of disymmetries between developing and industrial countries. In fact, the latter control the design, with the exception of some developing countries previously specified, the industrial know-how - with the exception of the HYL technological process and the use of charcoal as a reducing agent - and substantially all equipment and process supplies. Likewise, they control costs and finally - with a few notable exceptions - export capacities.

If a change of systems - such as a new international economic order - signifies the removal of constraints, one of the objects of international negotiations will be to limit or reduce constraints arising as a result of the above powers which may be used to block developments within a given period. Such powers must be carefully distinguished from the power of decision-making authorities in developing countries.. This is covered further on.

26. The various functions considered in the agreements have varying impacts and financial "weights". For example, for an investment at a virgin site, using the conventional route, the distribution is as follows:

Table 3

Functions	% of investment cost
Design and coordination function	10%
Industrial know-how function	5%
Suppliers' functions: with standard process 40%; with standard components 5%	45%
Contracting and transportation function	30%
Taxes	10%

To be complete the table would need to include information on the financial risks incurred by each of the functions in executing the projects. These risks vary from one project to another, but the main risks are assumed by the "contractor" function.

27. Faced with the industrialization requirements and the lack of design capabilities in developing countries, assemblers, due to their financial power may comply with the request for complete plants ready to operate. They offer their services in all branches of heavy industry.

28. In various countries suppliers of process equipment, consulting engineers and general undertakings having financial means become contractors. A number of these, however, have not followed this trend for various reasons, either because they had an actual monopoly (i.e. licences, processes, etc.), or a market orientated towards industrialized countries, or because they preferred to offer their services as a sub-contractor to an assembler, or because their sector of activity was located sufficiently downstream in the steel production process, or again because they did not have the necessary financial means, and this could have lead them to lose their autonomy to the benefit of banks or other firms.

29. Thus, when importing complex integrated plants, developing countries find themselves dealing with assemblers, and when constructing special workshops they have to deal with engineering firms and equipment suppliers.

The possibilities of competition or agreements thus vary.

30. In general, the list of partners will not include steel-making enterprises from developing countries. This is due to the fact that the engineering company or equipment manufacturer benefits directly from this help, or that through his industrial group the contractor may have recourse to the services of an integrated producer. In fact the producer's experience is transferred through the engineering company or supplier, but it is rarely directly transferred to partners in developing countries through the existing forms of industrial agreement.

In fact, developing countries easily find plant and equipment suppliers, but few steel companies ready to assist them in their steel production development. This situation is at the root of the difficulties when plants are commissioned and enter into full production.

31. The linking of controls has other effects. Assemblers rely on the financial and economic power of industrial groups. Their links with administrative political quarters and financial media allow them to obtain financing for their customers. On the other hand, in contracts with oil countries they have the implicit or explicit mission to participate in balancing the oil invoice by expanding the exportation of integrated capital goods(10). Because they are few in heavy industry, assemblers thus have the facility for establishing international relations amongst themselves to control market trends. Obviously this does not exclude competition, but at least it tempers it. In fact, increases in investment costs, more than proportional to the rate of inflation (see Dossier VII: Financing), leave no doubt that these are a <u>transfer of compensation</u> for the oil transfer.

The trend of investment costs, financing facilities, the distribution of technology and the quality of technology transfer cause worries in developing countries faced with the oligopolic situation in industrialized countries.

<u>Difficulties in managing construction</u>

32. Certain developing countries are tempted to select the most general contractual formulae in order to entrust the maximum of responsibility in the design and construction to partners in

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(10) This phenomenon is found in industrial countries which play an important role in the capital goods market. Thus it has been calculated that between 1973 and 1977, Germany paid more than half of the oil sum due to profits on the terms of manufactured goods trading. Michel Fouquin: L'adaptation aux conditions nouvelles de la croissance - in - "Spécialisation et adaptation face à la crise Etats Unis, Japon, Allemagne, France, Royaume Uni" - Economie prospective internationale - January, 1980

industrialized countries. In other cases they have no other choice. In fact, even in sub-contracting formulae, the investor cannot escape the non-transferable liabilities of the owner.

He must face up to the difficulties inherent in exerting his responsibility and problems arising while executing the project in accordance with the contract formula chosen. A sketch of the resulting administrative tasks is shown below, thus supplementing the general aspects described in Dossier V: "Labour and the development of human resources".

33. An analysis of the difficulties common to all modes of construction may be useful in distinguishing the typical weaknesses of developing countries and offer a framework for consideration.

In the construction stage, the owner will encounter the following typical problems:

- the nature and quality of relationships with the partners (effect of technology on the environment);
- the promotion of local manufactures, works and services; influence on the cost, deliveries, quality and financing;
- adaptation of technological choices to local conditions: definition of limits for the use of local materials, packaging of equipment (for example tropicalization), the possibility of sub-contracting, the possibility of effecting technological transfers, etc.;
- checking progress against technical design planning, and ensuring that it is compatible with the programming of sub-structural works: inspection, follow-up, quality and quantity control, controlling speed of decisions, etc.;
- control of the budget: scheduling of expenditure, requirement for funds, transfer of foreign currency, administration of credits, calls for funds, etc;
- implementation of personnel and administrative organizations in liaison with the planning department, control of personnel, quality of training policy: recruitment, training, supplies, customs clearance, etc.

- assistance to foreign partners in administrative and technical operations with local authorities: partners' tax, customs' clearance, work permits, building permits, problems involved in connecting supplies, etc.;
- selection of partners in order to obtain a real technological transfer;
- project final performance checks and capacity for settling disputes: performance tests, project balance sheet (negotiation, arbitration) etc.

All of these difficulties form the core of construction management problems in developing countries. The conditions required in order to make a success of this stage and to face up to the subsequent stages presuppose the following:

- an environment receptive to the introduction of the technology concerned;
- good human and professional relationships between local authorities, the project management team, project personnel and the various partners;
- a minimum of competence and potential qualities of the project management team;
- the adaptation of personnel and the team leader to the facilities and difficulties of the construction method selected, to ensure that they exercise their responsibilities effectively;
- a widely distributed competence among the parties to ensure that project and technology transfer objectives are achieved.

34. Without specifically analysing problems and difficulties encountered by developing countries in the various types of project, we shall limit ourselves to specifying the following:

- for turnkey formulae: a decision on the level of detail for preliminary studies, and its influence on commercial tenders, preliminary difficulties in defining lists of spares, problems involved in formalizing performance tests on a contractual basis, etc.;

- for breakdown formulae: the problems of distributing decision-making between the designer and the client, problems of budget revisions, limits on automatic "gadgets", etc.

B. THE MAIN PROBLEMS DURING PRODUCTION AND OF INDUSTRIAL KNOW-HOW

35. This second stage is difficult to separate from the first, but it also has its own difficulties. These are examined below.

The problems of developing human resources during entry into full production

36. This period is the most delicate, since it requires the progressive transfer of technical responsibilities to the owner's personnel, in particular to test the quality of equipment.

Problems encountered by the owner are therefore at the interface between the assimilating quality of the undertaking's human resources and the quality of the technological transfer.

Recruitment and training difficulties

37. Developing countries rarely have qualified and skilled labour, and when they build a steel project considerable difficulties are encountered in recruiting personnel at every level.

The lack of industrial skills will lead to an emphasis on scholastic qualifications, thus in general the youngest section of the population is of interest.

The individual training of these young workers is generally carried out quickly. However, their general understanding of the production process will be so sketchy that they will be inclined to consider their future position as underestimating their potential. To these frustrations is added the fact that it is necessary to organize a managing hierarchy as quickly as possible, and this results in various levels of command being selected from the same age group. Thus, selection cannot be based on practical experience, which is non-existent in young workers. In addition, the resentment of some of those who are not selected, and the small age gap between them and selected personnel, will weaken the command capacity and stability of the management. At another level personnel destined for production will often be advantageously placed with respect to maintenance personnel, whilst administrative posts will be entrusted (without prior training) to young people coming from a secondary education. These circumstances are likely to cause difficulties in the production stage.

38. The period of personal training for a young worker is generally carried out in plants of the same type overseas, in specialized training centres, then in a local plant. Overseas training poses a multitude of problems: quality of training, follow-up, supervision of young trainees in their leisure, regular contacts with their future managements, and linguistic and cultural problems. The wastage of young trainees and breaches of contract during their stay overseas, are facts which have to be seriously considered. They are the result of a professional rejection, a deliberate choice of another form of civilization and sentimental attachments developed outside their original environment.

In fact, it is not the candidates who are at fault. The situation is not the same as that obtaining in certain industrial countries where recruitment becomes difficult because of the present image of the "job" and the unattractive salaries[11].

39. To these personal, social, cultural and professional difficulties are added the problems of collective training using unsuitable training structures designed more for traditional training of individuals for individual requirements (see Dossier V).

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(11) See the study: "Changing maintenance requirements in the Iron and Steel Industry" - A report of a research study carried out by the Industrial Training Service on behalf of the Iron and Steel Industry Training Board, London, September, 1979.

The difficulties of technical assistance

40. The start-up of iron and steel installations is linked to the transfer of techniques by partners in the project (engineering firms, suppliers, etc.) but also by steel producing partners in the case of developing countries.

The main difficulties encountered are as follows:

- the disappearance of qualified design and project personnel who are transferred by the foreign party to other industrial operations. During the start-up period other newly expatriated foreigners arrive without a thorough knowledge of new installations and with local personnel in training. This causes discontinuity.

  The absence of methods for acquiring industrial techniques is reflected in the absence of transfer training(12) and the frustration of personnel under training who see this wonderful opportunity for learning pass with no clearly defined system of technological transfer. This results in a gap between the training acquired and the capacity to resolve problems in an unstabilized production stage, and finally a weakness of local management in resolving problems of this type.

Problems linked with industrial know-how

41. When installations have been commissioned industrial production begins and new difficulties then arise when the production threshold exceeds 50% of the production capacity utilization rate: it is necessary to control the production unit.

Industrial management may be defined as "the capacity to use, maintain, adapt and administer a production unit under optimum conditions for the type of production, the plant involved, specific constraints and environmental objectives. It is exerted through

(12) The effort to define technological transfer training in Silvère Serat's book "Réalités du transfert technologique" will be noted with interest - Ed. Masson, 1976.

organized production based on adapting, efficiently applying, broadening and capitalizing on experience acquired. It assumes the existence and utilization of formal supports in respect of technical production processes, maintenance inspection, programming, accountancy and cost control. It is based on the application of administrative facilities permitting decisions to be objective and to be decentralized as far as possible to ensure speed, efficiency, responsibility and control. It is reflected in the animation of all organizations, thus permitting a real distribution of administrative reflexes and the permanent mobilization of the human element. Finally, it is the result of thorough individual and collective knowledge, assimilated and expressed jointly to the benefit of an economic and social objective"[13].

42. In order to acquire this industrial know-how, it is necessary to combine the capacity of the receiving medium to receive and maintain the technology with the capacity of the industrialized party to control, transmit and adapt the technology.

In industrial reality, and in particular in the steel domain, these conditions are rarely met at any one time.

43. The industrial agreement formulae described previously leave little place for the true holder of know-how, namely the producer in an industrialized country. In addition, even when his collaboration is obtained, he will not necessarily have the capacity to adapt his technological knowledge to the particular problems of a developing country. Finally, the capacity of developing countries to acquire technology is often relatively limited by a lack of awareness, political motivation, and material and social encouragement by the authorities.

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(13) Definition of Mr. A. Benbouali

44. The acquisition of industrial know-how is achieved through the following processes: control, maintenance, inspection, adjustment, improvement, training, administration, innovation, design, construction and transfer, and this causes each stage to be programmed in terms of objectives, means and times.

Training programmes for administrative personnel should thus be linked as follows:

- for production: production and programming, productivity, work organization, improvement of quality, economy of materials, adaptation to market trends and standardization;
- for maintenance: maintenance, breakdowns and storage of spares, preventive maintenance and work organization, major repairs, equipment workshops and manufacture of spares;
- for administration: quantitative administration, accounts administration, administration by cost centre and administration by product.

Again, it would be advantageous to re-evaluate the method of training, to show means of overcoming difficulties in accordance with the size of enterprises and the technological processes.

45. Marketing problems are in themselves important. Consumers often use high prices, mediocre quality and late deliveries as the basis of criticisms against local products; but the worst irritation is the time needed for deliveries. National production is often protected against competitive products, and users find themselves forced to buy locally. Delays in the delivery of products do not allow them to stabilize their own activities.

Where producers are concerned, short production runs, their inevitable urgency, and the difficulty in clearing products disrupts programming, especially when the authorities stress priority for public or private orders. High domestic prices are the counterpart of export product promoting prices. However the possibility of exporting is an exception among developing countries. When such conditions exist, exporters must face the following disadvantages: quality of products, deliveries, prices, special standards, special packaging of products, and product quota systems for export to industrialized countries.

Internally, the introduction of distribution centres broadly covering the territory, and delivering the most common standard products, seems likely to reduce tension between producers and consumers.

46. During the production stage, developing countries must face up to difficult financing problems, due to the high cost of investment and the slow rate of achieving full production. These problems are dealt with in the following dossier (Dossier VII: Costs and financing), but it is of value to indicate specific traits at this stage.

In effect this is the period when, paradoxically, the authorities have generally estimated that they have already made the greatest sacrifices in establishing the project, and they become anxious regarding the repayment of foreign loans when poor production results are obtained. They find it difficult to analyse the situation cooly. In addition, since imports were previously obtained at lower prices, this gives a bad comparison reference for the financial administration and a poor image for consumers. Funding and product price problems thus become the daily preoccupation of the administrators.

47. Entry into full production directly influences the financing requirements during the operating period, due to its impact on the capability for repaying loans and any additional requirements which arise, caused by investments and due to final modifications to a project and any losses sustained.

These requirements are generally handled by bank organizations other than those involved in the investment financial arrangements. In addition, the easier it is to obtain project financing from bankers, the more they frown on further requirements during the transitory stage and the harder it is to resolve the problems. In general, bank organizations will reject any analysis until production is stabilized. However, the requirements remain and become greater: they may even approach the investment amount. Urgent solutions are therefore devised: aid, increased prices, take-over of infrastructure investments, reduction of tax on purchases, etc. In general, these measures are taken under the pressure of events and do not allow the problem to be resolved.

The political authorities then become anxious, take the dossier in hand and try to resolve the problem. This scenario is fairly common in industrialized and developing countries, but with the difference that since steel investment is less frequent in the latter, the authorities are much more careful vis-a-vis future investments in the steel sector.

C. SUMMARY

48. The dossier "Design and implementation of projects and the commissioning of new plants" shows the following problems:

a) The low project design capacity of developing countries leads to a risk that control is lost in essential choices, in particular with respect to technologies.
b) The importance of the physical and social infrastructures required for the steel industry creates a system of constraints which must be taken into consideration when designing projects. Consequently, a steel project is the installation of an industrial system with an integrating and polarising vocation.
c) The various modes used for implementing projects depend on different partners and introduce different kinds of difficulties. Industrial agreements are the polymorphic expression of the cooperation required by the parties, their method of association and the force relationships between them. It is thus difficult to generalize on the various situations. Nevertheless there are common features.

Firstly, the implementation is subject to unilateral control on the part of industrialized countries which control the design, the technological processes, the supply of capital goods and consequently, the costs and export capacities. Then, although industrial agreements involve agents such as assemblers, contractors and engineering concerns, direct cooperation between steel producers in industrial countries is looser and sometimes non-existent.

d) Assemblers are powerful industrial groups and bankers. The export of integrated capital goods leads to a considerable increase in investment costs, which often means a compensatory transfer to the oil bill.

e) When steel installations enter into full production, developing countries must face up to numerous problems, one of the most important being the adaptation of human resources. Technical assistance suffers from the absence of training in technological transfer. The same applies to training programmes for administrative personnel, who generally appear to be incompletely prepared for management of a complex steel plant and the relationship with its infrastructure. A reorientation of technical assistance and training appears to be a requirement for obtaining industrial know-how on steel plants in developing countries.

f) The problems of treasury financing during the operating stage are generally underestimated and are liable to be a serious burden on the operation of enterprises.

49. Starting from these problems, the following objects of negotiation may be identified:

a) The increase in the capability to design projects in developing countries raises the question of concrete training facilities in this domain in engineering companies in the industrialized countries, and cooperation with those in the developing countries.

b) This will involve an improvement in the publication of information on agreements between engineering companies and process owners. This also applies to methods and information provided during feasibility studies in order to permit the owner in developing countries to retain control of the essential options.

c) Faults in the various industrial agreement formulae lead one to investigate the possibility of involving steel producers in the industrial countries in direct cooperation with those in the developing countries.

d) The considerable difficulties encountered during the construction and operational stages in adapting the training of operators and administrative personnel lead to re-evaluating the training provided by the industrial countries, and to apply more effective training in technological transfer.

e) The financing structures seem unsuitable in numerous developing countries, and should be the subject of internal negotiation in these countries.

D O S S I E R   VII

COSTS AND FINANCING

1. The heavy iron and steel industry involves the mass production of heavy products. In order to operate, it requires very costly and large installations. The iron and steel industry forms part of the group of "capital intensive" industries.

2. The iron and steel industry is also a low profit industry; losses accumulated during the last few years by certain European steel companies have given rise to the idea of a declining industry from which no substantial contribution can reasonably be expected - certainly not quickly - to create an economic surplus.

Thus, the iron and steel industry raises questions of costs and financing, the weight of which is particularly heavy in the majority of developing countries.

A. COSTS PER TONNE INSTALLED

3. Unit costs have increased very rapidly; they have accelerated during recent years.

4. Fifteen years ago, the average cost per tonne installed for an integrated plant was about US$ 350[1].

In 1975-1976, it was estimated that the cost of an integrated plant on a virgin site was approximately US$ 800 per tonne[1].

In 1977, the approximate cost per tonne was considered by experts to be as follows:

US$ 1000/tonne in the case of integrated plants,
(1 million tonnes annual capacity)
US$ 700 to 800/tonne in the case of extension investments,
US$ 300 to 350/tonne in the case of small semi-integrated plants[2].

In fact, at this date, the above data probably correspond more to investment costs in industrialized countries than to investment costs actually incurred in developing countries.

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(1) In current dollars.

(2) W.T. Hogan: Future Steel Plants in the Third World - Association of Iron and Steel Engineers Yearly Proceedings, 1977.

5. In fact, it has been observed that the average cost of new installations in the Brazilian iron and steel industry reached the following levels in 1978:

on average	: US$ 1460/tonne
breaking down as follows	: US$ 883/tonne for light drawn products
	: US$ 1677/tonne for flat products
	: US$ 1850/tonne for special steels[3].

When the Japanese expert T. Kono estimated in February 1980[4] the installation cost of an integrated plant as US$ 1200/tonne[5] in industrialized countries, and US$ 1500/tonne in developing countries, these estimates were largely exceeded by escalating costs.

In 1978 the cost of the Brazilian ACOMINAS project (evaluated at US$ 900/tonne in 1973) exceeded US$ 1700 (including working capital and initial establishment costs)[6]. The cost per tonne of the Pakistani PIPRI project rose from approximately US$ 1200 in 1973 to US$ 1750 by the end of 1978.

At the beginning of 1981, US$ 1700 to 1800 per tonne installed were minimum figures for the construction of integrated plants.

An estimate of US$ 1730/tonne will be noted for the PARADIP project in India[7] (where know-how in the steel industry is already advanced), and an estimate of approximately US$ 1700/tonne for an extension of the SOMISA plant in Argentina[8].

Costs exceeding US$ 2000/tonne tend to become the rule, in such projects as:

- ZULIA in Venezuela: i.e. approximately US$ 3000/tonne (including coal mine)[9]

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(3) Congress of the Brazilian Steel Institute, Rio de Janeiro, April 1980.

(4) OECD: L'acier dans les années 80, Paris Symposium, February 1980.

(5) In accordance with AISI estimates in the United States, the installation costs (hypothetical) would be of the order of US$ 1,175/tonne. See AISI: Steel at the Crossroads, The American Steel Industry in the 1980s.

(6) Financial Times, 14 September 1978.

(7) Metal Bulletin, 5 December 1980.

(8) Metal Bulletin, 18 March 1980.

(9) Metal Bulletin, 8 August 1978.

- MISURATA in Libya: about US$ 2600/tonne(10)
- AJACKUTA in Nigeria: about US$ 3000-4000/tonne(11).

The costs of semi-integrated or integrated plants using an electric furnace/direct reduction system have followed the same progression. This is shown by the following projects:

- DEKKHEILA in Egypt : direct reduction process and electric furnace steelworks, approximately US$ 1250/tonne(12)
- JUBAIL in Saudi Arabia: direct reduction process and electric furnace steelworks, approximately US$ 1000/tonne(13)
- JIJEL in Algeria : direct reduction process and electric furnace steelworks up to production of billets, approximately US$ 2500/tonne(14).

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(10) Marchés Tropicaux, 2 January 1981, for a capacity of 1.3m tonnes

(11) Revue de Métallurgie, December 1980

(12) Moyen-Orient Sélection, 28 September 1979

(13) Metal Bulletin

(14) Proche Orient Economie, 9 April 1980

<u>There are various reasons for the increase in unit costs.</u>

6. In the first instance they result from the particularly rapid increase in capital goods for the steel industry from 1970: 35% increase between 1960 and 1970, and more than 65% increase between 1970 and 1975.

<u>Table 1</u>

(15)

1960	1970	1975
100	135	218

This upward movement continued after 1975: according to a study carried out in 1979, capital goods for the basic industries (including capital goods for the iron and steel industry) would have increased between 1973 and 1979 at an average annual rate three times greater than the inflation rate, i.e. approximately 30% per year[16].

In fact, capital goods for the iron and steel industry originate in the main from industrialized countries which, in spite of competition, are able to impose their prices. The manufacturing capacities available in India, Brazil and some other countries have not yet reached a level which permits them to effectively extend the competition and thus influence prices.

7. The cost of equipment has a direct influence on total amortizations and financial costs. This introduces a differentiation between iron and steel industries (new) in the developing countries and iron and steel industries (old) in the industrialized countries; on the one hand between entirely new investments and on the other between investments or extensions.

It has been estimated that in 1976 amortization and financial costs represented on average in the United States US$ 21.9 out of a total cost per tonne of US$ 364.8 (6.3%) and in Japan US$ 37.1 out of a total cost per tonne of US$ 248.3 (14.9%).

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(15) EEC "Investment in Community Coal-minery and Iron and Steel Industries" and P.F. Marcus "World Steel Supply Dynamics", New York, March 1976.

(16) North American British Committee - Basic Industries - London 1979.

By contrast it was estimated that in 1978 amortization and financial costs relating to an entirely new unit had risen to US$ 177 per tonne in the United States and US$ 199 per tonne in Japan, for costs per tonne installed of US$ 1,050 and US$ 700 respectively.

In the developing countries the average cost per tonne installed tends to exceed US$ 2,000. This is reflected in amortization and financial costs which oscillate between US$ 200 and US$ 400 per tonne[17] and hence reach a total which is equivalent to the cost of ordinary steel on the international market.

8. The increase in costs reflects the impact of conditions in the developing countries, where the construction of a steel plant:

- implies the construction of harbour, road and rail infrastructures and housing and social facilities;
- must count on additional costs involved in delays on programmes specified, these being likely to affect the amount of investment by 0.5% to 3% per month of delay. The major part of this surcharge generally involves a transfer in foreign currency[18],
- involves modes of the "turnkey" or "product in hand" inclusive type of project, leading likewise to surcharges (for the supply of additional services and for actual or extended cover of "risks") varying from 33% to 100%[19];
- assumes systematic and costly operations for training young inexperienced personnel, i.e. US$ 100 per tonne installed for the Libyan project at MISURATA[20].

(17) Mr. D'Astier, SEAISI Quarterly, (last quarter 1980) estimates the total of amortizations and financial costs as 15% of the cost per tonne installed. Cf. also the paper by S. Gerdan Johann Peter at the ILAFA Congress in September 1980 (ILAFA Review, December 1980).

(18) Note from Mr. Benbouali, UNIDO, November 1980.

(19) ditto

(20) Marchés Tropicaux, January 1981, First evaluation.

Developing countries pay for the experience gained with costly construction periods and the purchase of training, technical or administrative assistance.

9. In this context where large size signifies increased construction difficulties, and increasing costs of coordinated operations to obtain technical and administrative expertise, the law of scale economies based on a simple relationship between volumes and surfaces tends to be brought into question, and no longer operates automatically and in a linear manner in every case.

The consequences of increasing unit costs

10. In the main, it is the developing countries which bear the weight of installation cost increases. The iron and steel industries of the industrialized countries which were developed during the last few years in Japan and, to a lesser extent, in Europe, have benefitted from costs per tonne installed of less than two to three times the costs currently borne by the developing countries. In addition they are able to increase their capacities at relatively reduced costs in the form of:

- modular extensions (20 million tonnes possible in Japan),
- simple extensions (30 million tonnes in the United States and 20 million tonnes in Japan)[21]

while the developing countries cannot escape the more costly investment per plant.

(21) "Brownfield" or "Rounding out", see Steel Industry Economics, by H. Mueller and Kiyoshi Kawahito, Japan Steel Information Centre.

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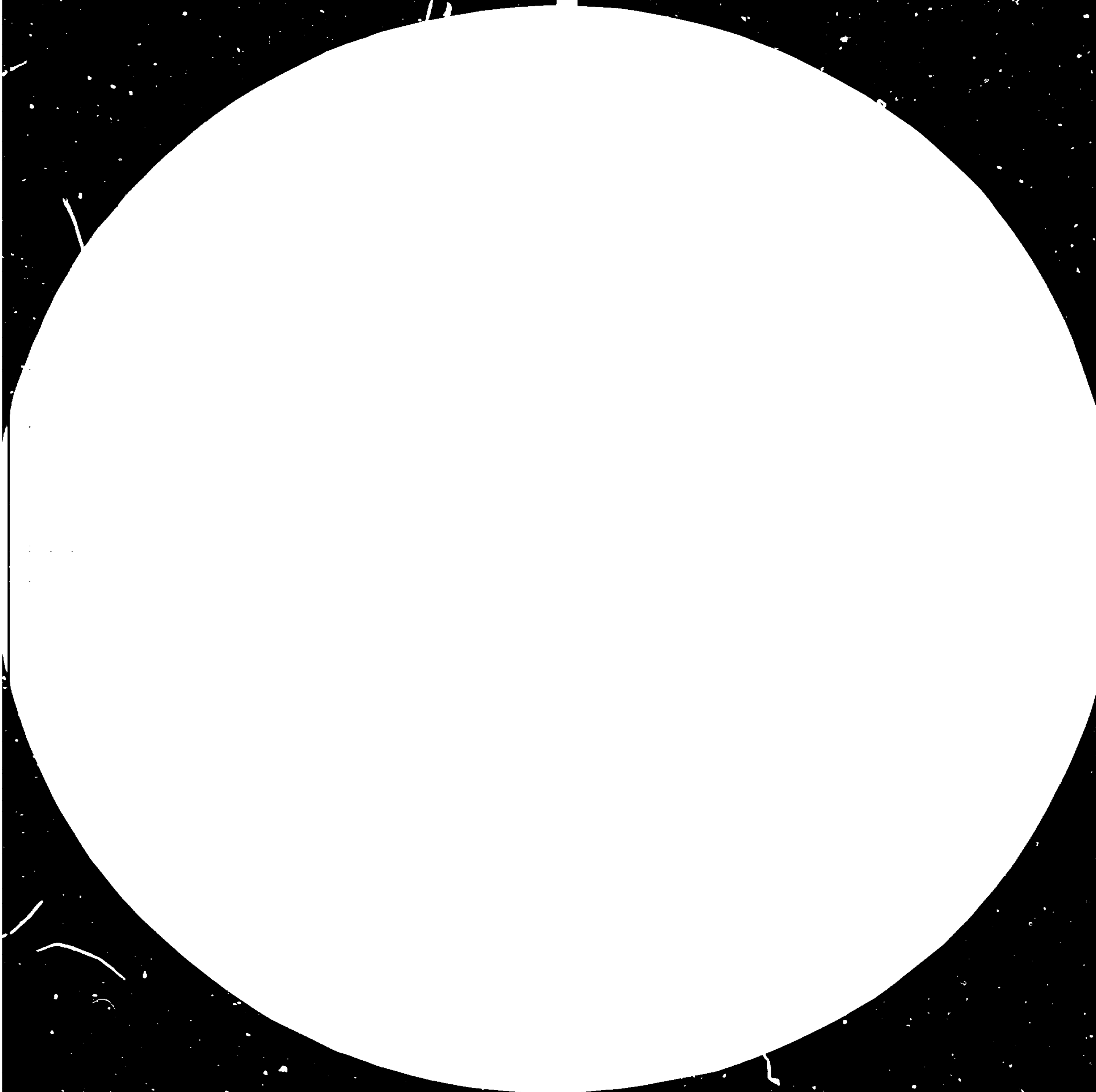

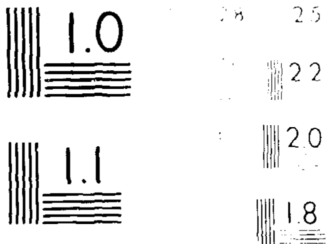

1.0
2.5
2.2
2.0
1.1
1.8

1.25 1.4 1.6

11. The increase in unit costs is making iron and steel investment a massive outlay which is incompatible with the financial capabilities of a large number of developing countries:

> the construction of a 1.5 million tonne integrated plant requires capital assets equal to US$ 3 billion, whilst the construction of a new steel capacity of 20 million tonnes in 10 years assumes that Brazil is capable of devoting to it US$ 3b, then gradually US$ 4b and possibly even US$ 5b per year.

12. The increase in unit cost has repercussions on the industry's operating costs. An installation cost per tonne of US$ 2,000 results in an approximate charge of US$ 200 per tonne of steel produced (approximately 10%). This magnitude is being approached by some costs and prices specified by the Brazilian iron and steel industry for the year 1978:

production costs	: from US$ 243 to 340/tonne
export prices	: from US$ 240 to 290/tonne
domestic selling price (drawn and rolled products)	: from US$ 420 to 480/tonne

It can be seen that such high costs upset the balance, if one may speak of a balance, in an operation where profitability has become a problem.

13. A negative consequence of the increase in cost of repayments and interest is that these tend to become a determining cost factor, whilst a reduction in operating costs of a few dollars requires a sustained and considerable effort[22]. This trend involves the risk of discouraging efforts to promote growth in enterprises in the developing countries.

(22) Article by S. Gerdan Johann Peter (ILAFA) - doc. cit.

B. STEEL INDUSTRY OPERATION: COSTS AND PROFITABILITY

14. The iron and steel industry is one of the industries particularly affected by the crisis; major European steelworks accumulate losses, whilst the Americans complain that they are caught between prices and squeezed by competition, after having been held at too low a level by administrative pressures and increasing costs. This is also the complaint and claim of European or Brazilian steel manufacturers.

Trends in prices and costs

15. Prices have suffered the impact of the crisis and fierce international competition on the open markets, even if domestic prices have been less affected than export prices. In real terms, at the end of the seventies, prices had hardly caught up with the level reached in 1974[23], while costs on the other hand had never ceased to increase. In the developed countries the average annual rate of increase of the main iron and steel inputs rose during the period 1965-1976 to 8.5% in the United States, 7.5% in Japan and 10.5% in Europe[24]. This rate then accelerated during the last period, 1970-1978, the rates then being 12%, 12.5% and 18% respectively.

16. In the developing countries the rate of increase in costs was even faster. In India, between 1965 and 1969, production costs increased on average 9% per year[25]. In Turkey, production costs leapt from US$ 393 per tonne of flat products and US$ 460 per tonne of long products in 1978 to US$ 636 per tonne of flat products and US$ 526 per tonne of long products in 1979[26].

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(23) Revue de Métallurgie - December 1980.

(24) H. Mueller and Kiyoshi Kawahito: cf. doc. cit.

(25) National Productivity Council of India "Productivity trends in iron and steel industry in India", 1974.

(26) D.P.T. "La structure de la siderurgie en Turquie et ses problèmes". Average production costs in Latin America rose to US$ 443 per tonne in 1978.

17. Cost trends are the result of highly differentiated trends for each of the main factors structuring these costs:

- in spite of a recent delayed recovery, the price of iron ore has undergone a relatively marked reduction. Between 1965 and 1979 the average price of iron ore and the average price of merchant bars changed as follows:

	1965	1979[27]
Iron ore	100	189
Merchant bars	100	415

- on the other hand the price of labour and energy underwent a rapid increase during the last two decades, and in particular during the most recent period:

	1960			1976			US$/tonne of steel[28]
	USA	JAPAN	EEC	USA	JAPAN	EEC	
1. Labour	62	27	23	128	50	91	
2. Iron ore and scrap	20	43	24	52	44	44	
3. Energy	18	20	17	59	61	70	

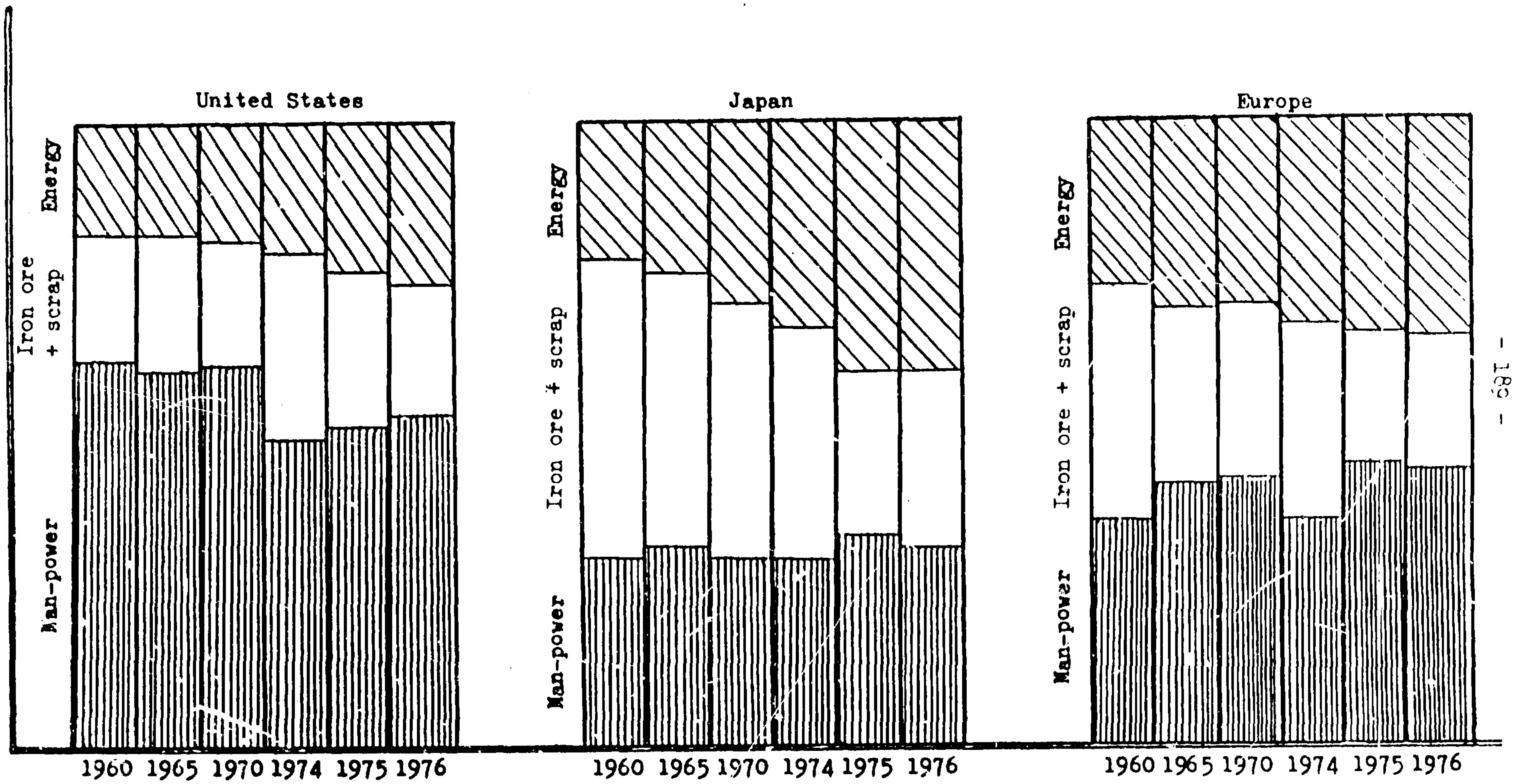
- some data has already been given relating to the trend of repayment and interest costs.

18. The appended graph shows the increasing influence of labour and energy with respect to the relative "weight" of scrap/iron ore. It will be noted in this respect that production costs are affected by similar trends in the developing countries:

. the same trend towards a reduction in the relative cost of iron ore;
. the same trend towards a rise in the relative cost of energy when coking coal and oil products are used. On the other hand, the availability of natural gas constitutes an increasingly remarkable benefit for countries which produce it in abundance;
. the same trend towards a rise in labour costs, the relatively low level of salaries being largely offset by low work productivity;

(27) Revue "Acier Arabe" No. 3 - 1980.
(28) H. Mueller and Kiyoshi Kawahito: cf. doc. cit.

Evolution of the structure of production costs by main inputs



. a highly pronounced trend towards a rise in amortization and financial charges. Personnel and amortization costs are rising, now representing more than 55% of production costs in certain new steel industries instead of the 40% figure in certain European steel industries.

Profitability in question

19. As a result of the trends in costs and prices, the "profitability" of the iron and steel industry is brought into question. Profits only appear at the end of a long period. The first dividend was only distributed in 1975 to shareholders of the Brazilian company USURINAS which started in 1956. Today the iron and steel industry is regarded as being a business with little profit, and even as an unprofitable business which should be treated as a public service. According to the World Bank, "few new iron and steel projects are today likely to satisfy reasonable criteria of economic profitability"(29).

20. Nevertheless, it is noted that the results obtained by the various steel companies are not all negative. Whilst French, British and Italian companies accumulate losses, the main German companies maintain their financial equilibrium and the Japanese companies are increasing their profits in spite of market shares of 70% or less.

Table 2

	Financial year 79/80 compared with 78/79		
	Turnover	Profit before tax	Net profit
Nippon Steel	+ 17.9%	+ 122%	+ 134%
Nippon Kokan	+ 13.4%	+ 156%	+ 144%
Kawasaki Steel	+ 19.5%	+ 131%	+ 187%
Sumitomo Metal	+ 19.0%	+ 140%	+ 156%
Kobé Steel	+ 15.9%	+ 55%	+ 87%

(29) J.W.P. Jaffé at the IISI Congress on behalf of the World Bank in October 1977.
- Report of proceedings, page 107.

21. The German and Japanese iron and steel industries have a common feature in that they are strongly or very strongly integrated downstream with the market on the one hand, and with the converting of steel products on the other.

The five large Japanese steel manufacturers, like the German Thyssen, Krupp, Mannesmann or Klockner companies, are also large engineering firms, engineering suppliers and industrial groups whose steel-making activity is made use of and whose profitability is closely linked with downstream activity. The control which is exerted from one end of a process to the other also permits control of the value transferred from upstream to downstream, from the production of iron ore to the production of steel on the one hand, and from the production of steel to the production of machinery and equipment on the other.

An investigation into the development of the French productive system between 1959 and 1972[30] identified this same general transfer process from upstream to downstream, and in particular from intermediate industries (including steel making) to capital goods industries.

22. The evaluation criteria proposed by different people (i.e. the head of the Algerian steel company and a spokesman for the World Bank) come within this perspective of valorization (profitability) through the downstream link.

The former General Manager of the National Steel Company declared [31] in effect that "The Steel Industry in Algeria is not ashamed that it is a "non-profitable" industry. It refuses to make a secret of the fact or to hide it with price manipulation. On the other hand, it knows that its mere existence, by the upheaval which it implies and which it requires to ensure its survival and development, creates a new and ever more integrated industrial world, expanding under its own weight, in which its usefulness and profitability (since this is the end-product of usefulness for us) will be undisputed ..... The most important aspect of the steel industry phenomenon is the industrial drive which it engenders. Thus, we have no fear of seeing the steel

(30) INSEE "Fresque historique du système productif", Series E, October 1974, pages 135-142.

(31) M. Liassine: Paper at the 1st Seminar of Arab steel-makers, Algiers, December, 1970.

industry divert part of the national income for its own benefit, and we feel that an investment in steel-making is an investment in all sectors".

On the other hand, before the Congress of the International Steelmakers Institute Mr. Jaffé recognized that "the main justification for building an iron and steel industry in a developing country today is the desire of the country to become self-sufficient in the production of basic materials required for the engineering industry and to provide protection against sharp fluctuations in the export price of steel. All of this is based on the certainty that a national steel industry will contribute to the acceleration of industrial development in general and to the growth of steel consumer industries in particular"[32].

23. These analyses allow a link to be made between the trend in costs, profitability, economic transfers between sectors and financing problems. The rapid increase in costs and low or non-existent profitability explains the difficulty in guaranteeing the financing of projects. Nevertheless, it will be noted that money lenders are interested in numerous projects, regardless of the difficulties involved: this would be incomprehensible if steel making did not make downstream operations profitable, thus ensuring the commercial (and finally profitable) nature of the iron and steel industry.

C. FINANCING THE IRON AND STEEL INDUSTRY: CONSTRAINTS AND PROBLEMS

Preliminary note: self-financing and indebtedness

24. The history of the iron and steel industry during the last twenty years shows that the performance of the various national steel industries has been very diverse where the structure and origins of financing are concerned. From 1961 to 1971, Northern European countries and the United States based the vitality of their growth mainly on their self-financing capabilities (62.9% and 55.2%

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(32) M. Jaffé: IISI Congress, October, 1977, see page 108.

respectively in the United States and Western Germany). However, Japan and Italy preferred to borrow, and their percentages were 26.4% and 20.4% respectively(33). This has not prevented either the Japanese or Italian steel industries from making great progress. It is true that the historical and economic context of these steel industries is very different from the context of steel industries created or projected today in developing countries. In fact, steel industries are rarely sufficiently advanced to possess appreciable self-financing capability. It is estimated, for example, that the self-financing capacity of the Mexican iron and steel industry was of the order of 26.8%, while that in Argentina did not exceed 12.7%(34). In the case of Japan the borrowing mode of financing is typical of the national economy; it is administered and directly fed by the national bank system. On the other hand, where the financing of iron and steel industries in the developing countries is concerned, the absence of self-financing capabilities signifies not only recourse to sources of financing outside the industry, but in general means obligatory recourse to foreign sources of financing, using a foreign financing system, with respect to which the margins of manoeuvre and freedom are narrow and sometimes non-existent.

25. The weight of financial constraint already weighs heavily on the iron and steel industries of the developing countries, and it will be even heavier in the coming years. The order of magnitude of the cost of realising iron and steel projects launched or studied in the developing countries up to 1990 will be US$250 billion.

26. The implementation alone of development plans for the Brazilian and Mexican steel industries will involve respective costs of approximately US$ 40b to 50b and US$ 30b to 40b, corresponding to an average annual expenditure of US$ 4b to US$ 5b in the case of Brazil and US$ 3b to US$ 4b in the case of Mexico, with a total of US$ 9b to US$ 11b per year for the whole of Latin America. In 1977, US$ 2,630b alone was

(33) Le financement des investissements dans la sidérurgie mondiale de 1961 à 1971 - IISI Brussels, 1974

(34) Siderurgia Latino Americana - No. 221 - September 1978.

devoted to iron and steel investment in this continent[35]. This highlights the amount of capital which has to be mobilized and, consequently, the weight of constraint which must be removed to permit such mobilization.

27. Numerous recent examples show the weight of the financial constraint and the transfer of decision-making capabilities to the money lender, who finds himself effectively in a position to halt, delay or advance a project.

Because of lack of financing, numerous steel projects have been cancelled: the ITAQUI I and II projects in Brazil, the NADOR integrated steel project in Morocco, the TIKA project in Zambia, the integrated plant project in the Philippines, etc. Others have been delayed or postponed from one year to another: in Argentina the extension projects of SOMISA and SIDINSA, in Venezuela the ZULIA project and in Brazil the ACOMINAS, TUBARAO projects, etc.

28. Other projects encounter fewer financial difficulties. This is generally the case with projects started in hydrocarbon producing countries, in particular the Libyan project which will obviously be a unique example of a steel project built without borrowing. However, certain projects are moving forward, including some in non-oil producing countries, and the possibilities and modes of financing are analysed below.

Participation of firms and direct investment

29. The participation of foreign firms in the capital of new projects launched in developing countries is an old process, currently characterized by simultaneous advance, stagnation and withdrawal.

30. The process tends to expand into the field of iron mines: the majority of the mining projects being implemented or studied generally include direct financial participation by public or private foreign groups: in Australia, Liberia, Senegal, the Ivory Coast, Gabon, Argentina and Mexico. It is the systematic policy of the large

(35) Metal Bulletin 25 July 1980.

Brazilian state mining company, Companhia Vale Do Rio Doce (CVRD) to enter into joint ventures with various foreign companies.

Table 3 (36)

Participating company	% participation	Subsidiary	Field of activity
C.V.R.D.	51	Minas Da Serra Geral SA	Iron ore
KAWASAKI (Japan)	49		
C.V.R.D. BOZZANO SIMONSEN (Brazil) NIPPON KOKAN (Japan) NIPPON STEEL (Japan) MARUBEN (Japan) KOKAN MINING (Japan)		Mineraçao Hime Ltd.	Iron ore
C.V.R.D.	50.9	Amazonia Mineraçao SA	Iron ore
US STEEL (USA) (withdrawn from project)	49.1		
C.V.R.D. NIPPON STEEL (Japan) NISSHO-IWA TRADING Co. (Japan)	51 49	Nibrasco	Pelletization
C.V.R.D. FINSIDER (Italy)		Itabrasco	Pelletization
C.V.R.D. INI (Spain)	51 49	Hispanobras	Pelletization

31. This procedure is also frequently used for special steel projects, for example MEXINOX in Mexico and MAHINDRA in India, with the participation of the French PUK Group (Ugine Acier), or the special steels plant projected in Nigeria with the participation of the Indian Company BIRLA, whilst NISSHIN STEEL (Japan) has a share in the capital of ACERINOX in Spain and Creusot-Loire has a share in the capital of ACEROS DE LLODIO, also in Spain.

(36) Source: H. Erdemli "Stratégie d'une entreprise d'Etat minière, le cas de la C.V.R.D." - IREP, Grenoble, September 1978.

32. On the other hand, the situation is ambiguous in the field of standard steel production (medium or large projects); whilst certain firms are increasingly withdrawing, for example US STEEL with respect to Spain or Brazil, others continue to show an active interest in steel-making in developing countries. This applies to the following in particular:

- German and Luxembourg firms, i.e. ATH, Mannesmann, Klockner, Korf and Arbed in Brazil (Mannesmann, Belgo-Mineira and Cosigua extensions) in Malaysia and in the Gulf.
- Japanese firms in Brazil, Argentina, Mexico, Egypt, the Gulf, ASEAN, etc.
- Italian firms in Brazil, Zaire, etc.

Firms interested in direct investment overseas are, in general, large firms, but it is noted that initiatives are also taken by smaller firms, for example in Nigeria, Cameroun or Liberia where medium or small projects are involved.

Certain developing countries reject proposals for direct acquisition of holdings. Others, on the other hand, seek such proposals, but refuse or are reticent with firms whenever the latter consider that the risks are too high or that the guarantees are inadequate.

Financing and guarantees: The role of the State and international organizations[37]

33. The first reaction of investors and finance companies is, in fact, a demand for solid guarantees against the risks incurred. Two types of organization provide such guarantees.

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(37) For an analysis and details of the various financing funds, see A.R. Parish and O.J. Zeman "Financing the steel industry in developing countries" in The Steel Industry in the Eighties, Metal Society, 1980.

34. The first is the national State and its own organizations. "The success of an iron and steel project started in a developing country assumes, in fact, total support of the Government in particular in respect of financing" ....[38]. Thus, it is not surprising that State control of an iron and steel industry should be rapidly extended: States controlled 23% of world steel production in 1950 and 53% in 1980. In the Third World this proportion rose, during the same period, to 80%, the majority control of the State operating in countries with political regimes as different as Algeria, Brazil and Korea. State guarantees facilitate financing arrangements: they als facilitate participation in joint ventures with foreign firms. Examples of this are numerous, i.e. in Brazil (USIMINAS and TUBARAO projects), in Nigeria (special steel projects), in Mexico (Japanese-Mexican project), in Argentina (SOMISA and SIDINSA projects) and in Egypt (the DEKKHEILA project).

35. The second comprises international financing organizations and, in particular, the World Bank group to the extent where ".... even if contributions from the World Bank to Third World steel industry financing are on a relatively small scale, the approval of this organization is regarded by other lenders as a guarantee ...."[39]. In fact, in this field, the World Bank group plays several roles:

- firstly, by direct participation through the International Financing Company, it offers a guarantee to direct investors: cf. the participation of the IFC in capital for MEXINOX (Mexico), COSIGUA (Brazil), DALMINE (Argentina), th KOC and BORUSAN projects (Turkey), the AHWAZ projects (Iran), etc.
- secondly, through agreed loans, the Bank opens the way to other public and private lenders. Loans from the World Bank to the iron and steel industry, which were rare, have increased during recent years to US$ 563 billion over a period of six

(38) Communication from M. Jaffé, op. cit.

(39) M. Jaffé, op. cit., page 107.

years, financing more than 10% of the cost of eight large steel projects in Brazil, Mexico, Turkey, Egypt, Iran, etc. A question arises regarding the possibility of an even more pronounced undertaking by the Bank to finance the iron and steel industry during the eighties in order to permit an improvement in the general financing conditions (i.e. duration of loans and interest rate) and to offset the probably increasing reticence of "commercial" money lenders.

Financing iron and steel production: structure of loans and lenders

36. Borrowing is thus the essential requirement for financing new iron and steel industries in developing countries. Installations based on project financing involve not only the World Bank group but a series of actors ranging from foreign states to Euro-market lenders.

37. The limiting case is a Saudi State loan of US$ 220 million to Syria for the construction of a pipe-making unit. The loan was granted in 1975 and was to be repaid, free of interest, over thirteen years, starting in 1983 !

38. Certain arrangements involving public and private actors represent a deliberate policy of co-operation by a foreign State. For example, the Japanese State is arranging an external loan totalling approximately US$ 300m for constructing the first integrated steel plant in the Republic of Korea under the following conditions:

Japanese Government	: US$ 31 million
Overseas Economic Cooperation Fund	: US$ 46 million
Eximbank of Japan	: US$ 50.5 million
Bank credits arranged by the Japanese suppliers (i.e. Nippon Steel, Nippon Kokan, etc.).	: Approximately US$ 170 million

Financial arrangements made within the framework of Soviet cooperation (with India, Pakistan, Iran, etc.) are similar to the above.

Table 4 : Some examples of Japanese loans to the Brazilian Steel Industry

Steel company	Date of loan agreement	Amount of loan (Millions ¥)	Period of repayment (years)	Period of grace (years)	Interest rate	Notes
CSN	4.10.1972	16,500	15	3	7%	Used completely
	26.5.1976	65,000	15½	3½	8%	Not spent
COSIPA	4.10.1972	20,000	15	3	7%	Used completely
	26.5.1976	40,000	15½	3½	8%	Not spent
USIMINAS	4.10.1972	20,000	15	3	7%	Used completely

Source: IETRO, Economic Cooperation of Japan 1979.

Table 5: Some examples of loans from the World Bank

Steel company	Country	Date of loan	Amount of loan (US$m)	Interest rate
CSN	Brazil	February 1972	64.5	9%
USIMINAS	Brazil	April 1972	63.0	9%
ERDEMIN	Turkey	April 1972	76.0	8¾%
COSIPA	Brazil	June 1972	64.5	9%
SICARTSA	Mexico	September 1973	70.0	9%
CSN	Brazil	August 1975	95.0	10%
COSIPA	Brazil	August 1975	60.0	10%

Source: Federal Trade Commission - Bureau of Economics, November 1977

39. "Supplier" credits (or even "purchaser" credits) are linked to the overseas supplies which they are designed to promote[40]. Credits granted by the "Eximbanks" (of the United States or Japan) are also associated with equipment exports. It will be noted that, in both cases, these two credit categories benefit from official cover, coming directly or indirectly from the supplier's country (through its banks, insurance companies or Administration).

40. Credits granted by commercial banks generally grouped in consortia or in syndicates (the 98 banks controlled by Morgan Grenfells for financing the Brazilian ACOMINAS plant - US$ 505 million) are sometimes negotiated by the main equipment supplier or group of suppliers. It is certain that a loan agreement is facilitated by the presence of the States, World Bank or an International Organization (Inter-American Development Bank).

41. From credit granted by commercial banks, we pass to credits contracted on the European market or its "periphery" where the contractor (country) plays a more decisive role than interest in the project itself or the prestige of his sponsors.

42. In all cases it is found that financing conditions have tended to become more rigorous in respect of the duration of loans, periods of grace and interest rates, particularly during the recent period.

The financing conditions which predominated ten years ago were an average loan period of fifteen years, a period of grace of 3 or 3½ years and an interest rate of 7%. Today the tendency is towards medium-term loans of less than ten years, and interest rates have escalated to above 10%.

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(40) On this subject, see the dispute between the USA and the EEC regarding the more favourable conditions of credit granted by certain countries.

43. This is a dangerous trend for the future of steel manufacturing in numerous developing countries, especially as the demand for essential credits involves linked credits, and hence competition with the expansion of local capital goods production and services. In addition, the demand for additional credits on the Euro-market risks compromising the financial balance of new plants due to the credit period being totally unsuited to the effective rate of entry into full production.

44. Finally, considerable attention will be given to the fact that States and International Organizations become key-actors in financing arrangements for Third World steel companies, either directly as a result of the funds which they provide, or indirectly because of the guarantees which they offer. The role played by Banks is obviously not negligible, but it tends to become secondary to the extent that the banks concerned are governed most of the time by the positions taken by the public actors concerned.

The financing of steel production : new openings and possibilities?

45. The financing constraint does not exert a uniform impact on the various developing countries; it is of little consequence in countries rich in hydrocarbons and has no affect at all in countries with a low population which are oil exporters such as Saudi Arabia, the Emirates, Libya, etc.

46. The increase in the price of oil between 1979 and 1980 gave oil exporting countries a new financial capability. For the moment, apart from financing national steel installations in Saudi Arabia, Gabon, the UAR, Oman, Iraq, Iran, Libya, Algeria, Nigeria, Mexico, Trinidad, Indonesia, Malaysia, etc., oil capital and in particular Arab capital, has only exceptionally participated in financing steel installations in foreign countries.

47. The only existing projects financed by the latter are as follows:

- a mining project at Guelb, in Mauritania, financed jointly by the Arab, Saudi, Kuwaiti and Abu Dhabi Funds, the Islamic Bank and OPEC, and a rolling mill project at Nouadhibou financed by the Abu Dhabi Fund. (Information supplied by the Secretary for Arab Funds Coordination in Kuwait);
- a pipe production project in Syria based on Saudi capital;
- a pelletization project in Bahrein (for supplying direct reduction plants in the Gulf) based on Kuwait, Iraq and Saudi capital).

48. For the moment the developments are therefore limited, but the financial potential of oil exporting countries is considerable. This certainly constitutes a possible broadening of financing sources for new iron and steel projects in the developing countries[41].

49. Meanwhile the main money lenders in the industrial countries show sustained interest in a certain number of countries or regions which they consider promising for more global cooperation. It is obvious, for example, that Mexico, Brazil, the Gulf region, Malaysia and Indonesia are included in these areas, since technical aid and financial participation is liable to encourage profitable reciprocal arrangements, for example in terms of supplies of hydrocarbons and raw materials, or in terms of outlets for industrial products and services. From this point of view steel projects will probably obtain approval and financing in Mexico and Brazil rather than in Africa south of the Sahara, and in Indonesia and Malaysia rather than in the Philippines, etc.

Large reservoirs of raw materials, large producers of hydrocarbons and large markets of today and tomorrow possess advantages which will

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[41] OPEC development funds now being constituted could, if necessary, become an adequate institutional framework for such operations.

make them interesting and even sought after borrowers during the eighties.

50. The second world study also drew attention to the more global and complete forms of cooperation starting with an analysis of the Brazilian example of TUBARAO* which, simultaneously, involves : a national state (Siderbras 51% of capital) and foreign steel firms (i.e. Kawasaki Steel and Finsider with 24.5% of capital each). The demand for capital is met by the State and firms wishing to expand their field of operations, but which are also on the lookout for supplies of raw materials as well as outlets for their techniques and equipment. The resulting cooperation is not free of contradictions, to the extent that the additional capital supplied by the Japanese party (loan of US$ 700 million) is linked to the Brazilian party purchasing Japanese equipment which the Brazilian industry has the means of producing. But the project proceeds within a framework of cooperation which involves more extensive reciprocal arrangements and more global interests.

51. The participation of the Soviet Union in the construction of steel plants in several developing countries apparently shows both analogies and special features :

BOKARO (second stage) and VIZAKAPATNAM (negotiation on first stage) projects in India
PIPRI project (being completed) in Pakistan
ISPAHAN project (second stage) in Iran
ISKENDERUN project (second stage) in Turkey
HELOUAN project (second stage completed) in Egypt
ELHADJAR project (second stage being completed) in Algeria
AJAOKUTA project (first stage) in Nigeria.

The agreements concluded for implementing these projects involve Soviet participation in financing and the supply of equipment and technical assistance; they sometimes include the repayment of loans

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* UNIDO - Deuxième étude mondiale sur la sidérurgie, 1978.

(in general partial repayment), but, and, this is a special trait, sometimes payment in kind, starting from the time a plant enters into full production.

52. These agreements are included in the more global cooperation undertakings which generally exceed the strict framework of steel manufacturing, made in general with countries (cf. above list and Annex 1) whose weight, evaluated in terms of mining or oil riches, existing markets or potential, or strategic positions, is not negligible.

53. Finally it will be noted that <u>South-South relationships</u> are starting in the steel manufacturing domain, for example :

- between the Republic of Korea	and	India : agreement linking technical cooperation to the supply of iron ore.
- between India (Kudremukh iron ore)	and	Iran then USSR Trinidad Pakistan
	and	Nigeria, with BIRLA group participation in capital for a special steels plant
	and	Middle East (Abu Dhabi, Oman, etc.)
- between Brazil (COFERRAZ and TENENGE groups)	and	Paraguay : supply of capital, equipment and technical assistance for the new plant at ACEPAR
- between Algeria	and	Guinea : for the supply of iron ore direct reduction unit at Jijel
- between other Asian countries	and	Nigeria : for the construction of a small plant in a joint venture

54. These relationships also seem to offer advantages to zones having mineral resources (iron ore) or hydrocarbons; their development hence reinforces the polarization and differentiation phenomena which have already been noted.

D. SUMMARY

55. The "Financing" dossier allows the following problems to be identified :

a) The rise in unit costs (per tonne of capacity installed) has accelerated; it results :

- from a development specific to the industrialized countries (the price of capital goods as a privileged means of exchange)
- and a situation specific to the developing countries which is that of the logic of the costs of training (these being higher in larger plants).

The rise in unit costs has repercussions on the increase in production costs, and the tendency seems to be maintained throughout the decade.

b) The iron and steel industry suffers from a double squeeze between costs and prices: input costs which increase (in particular energy and equipment) and rolled product prices due to the pressure of the world crisis. It thus suffers, rather than profits, from excessive intersectoral economic transfers.

c) In fact, regardless of its strategic aspect, the iron and steel industry only finds its full economic justification when integrated in a long process which extends up to the converting of steel products (the engineering industry). The inclusion of an engineering sector governs the qualitative level of steel production and also the economic costing (profitability) of a "polarizing" industry.

High unit costs and low profitability combine to increase the financing constraint on the iron and steel industry in developing countries. This financing is an internal constraint due to the amount of financing required compared with the internal availability of capital. It becomes a heavy external constraint due to the unavoidable call on foreign capital. Borrowing conditions (duration of loans and interest rates) have a tendency to deteriorate in the existing context of crisis and budgetary restrictions, in particular to the detriment of countries having fewer natural (raw materials and energy), economic (potential markets) or strategic assets.

56. The dossier leaves the impression that the principal hypothesis in respect of financing is the deterioration of the situation for non-oil producing developing countries in the eighties. Due to the combined effect of the increasing cost of energy, the cost of imported equipment, and the relative drop in the price of steel (at least for standard steels), the outlook is more towards abandonment or delay in the implementation of projects (see Dossier I) than the preparation of new projects.

Thus, financing appears to be a discretionary hypothesis for the 1990 scenarios.

It follows that the greater or lesser participation of the developing countries in the world iron and steel industry will depend, in the first place, on the response to this problem.

57. The objects of negotiation concerning financing may be envisaged more or less broadly.

a) In the broad sense, general negotiations relating to the control of the respective ore, scrap, coking coal, steel, equipment and energy markets (the prices of the latter being in fact indices of inflation in the predominant currency). The matching of financing would be the crowning point of these general negotiations.

We know that considerable difficulties arose in controlling steel markets within the EEC, which related to a more limited objective. An increase in the number of partners and negotiating objectives would introduce more complications. It would thus not be very realistic to think of extending this undertaking to a world scale, even though this is the real dimension of the problems.

b) A less ambitious solution would be to increase the transparency of the various markets on the basis of the existing projects in developing and industrial countries. From this ongoing analysis planning details could be obtained and used as a guide in making special decisions, in particular with respect to financing.

c) A "mini-negotiation" would cover the increased financing granted to the iron and steel industry in developing countries and its conditions, with a view to permitting implementation of 1990 projects (see Dossier I) and new projects.

A detailed summary of listed 1990 projects should permit the order of magnitude of the required financing to be established, (estimated as US$ 250 billion), the expected sources, the shortages to be overcome and modifications to be made to financing conditions, in particular for the less favoured countries and countries whose projects are geared essentially towards local markets. This is the case in particular for African projects, the implementation of which would be an effective contribution to the continent's industrialization.

d) The financing of the infrastructures necessitated in a country without an industry for the establishment of an iron and steel on the one hand, and the financing of the training of the personnel for the future unit on the other, should benefit from special conditions of loans (rates of interest, periods), or possibly even of gifts.

e) The problems related to the financing of costs in local currency related to the construction and erection should also be taken into consideration and be the subject of appropriate solutions.

f) In any case, for the eighties, the transfer of financial resources brings into play three main types of actor at the present time:

- State actors who play a determinant - direct or indirect - role in the granting of loans; their intervention thus constitutes a key factor in negotiations relating to financial constraint, especially as cooperation in steel-making is generally a facet of more extensive and global agreements;

- the World Bank, which increasingly plays the role of catalyst in the domain of financial arrangements, and whose facilities for additional contributions would need to be explored;

- oil states, whose capital has until the present been little used in financing steel manufacture; they nevertheless constitute a widespread potential capable of funding South-South cooperation, and of interest not only to the large countries and those acting as reservoirs of raw materials, but also less favoured developing regions and countries.

g) Several recent examples indicate that assemblers and manufacturers of capital goods are active agents when mounting financial operations based on the production to be produced by the future iron and steel unit (buy-back). This is a path to be followed and possibly to be extended by examining various possible forms of "North-South", "North-South-South", agreements, etc.

Possibilities therefore exist, and these should be extended. At all events the positions taken up by the various partners in regard to this crucial variable largely determines the configuration of the scenarios.

Annex I

Financing Structure
of some iron and steel and mining projects

UNIDO - Finance for Steel - BSC (Overseas Services Ltd.)

Project	Country	Estimated cost of project (in US$)	Financing structure	Notes
SICARTSA First stage	Mexico	678 million (1973)	Nominal capital 44% World bank loan 10% Inter-American Bank 8% Bilateral foreign credits 27% Other loans 11% 100%	Mexican state In general, loans to 15 years (7-9%)
AHMSA Extension	Mexico	222 million (1976)	Suppliers' credits 45% Euro-market loans 37% Other loans 18% 100%	
ACOMINAS	Brazil	3.037 million	Nominal capital 33% Eximbank 2% European suppliers' credit 16% European credit for covering local costs 2% Euro-market loan 16% FINAME loan 29% National Housing Bank loan 2% 100%	Brazilian state 12-15 years, except Euro-credit (5, 6 to 7 years) (7 to 9%) 7 to 9%

(contd.)

Iron ore mines				
SAMARCO	Brazil	594 million	Nominal capital : US$ 288 m. 51% SAMITRI 49% Mutali Internat. Corp. Loans : US$ 312 million of which 194 from a consortium of banks 100 from another consortium (including Eximbank) 18 from Caisca Economica Federal	
KUDREMUKH	India	717 million (1978)	At the start NMDC (India 51% Marcona Corp. 25% Mitsui Co. 8% Nissho Iwai 8% Okura Trading Co. 8% Then NMDC alone with Iranian financing Then NMDC alone	
MOUNT KLAHOYO	Ivory Coast	1.278 million (1975) = in fact 2.. ; million	- Capital envisaged : US$ 640 m. Japanese group 45% European group 45% Soc. pour le développement minier de la Côte d'Ivoire 5.5% Others 4.5% - Suppliers' credits : US$ 772 m. Local loans : US$ 100 m. Bank consortium : US$ 623 m.	
Iron and steel units				
DALMINE-SIDERCA	Argentina	1.536 million	Nominal capital 23% Eximbank loan 15% Eximbank guarantee on commercial loans 20% European suppliers credit 17% SFI loans 10% Argentinian loan 10% Others 5% 100%	Duration of loans 10 + 4 yrs. 7 + 4 yrs. 5 yrs.
ANTARA	Malaysia	13 million	Nominal capital 28%	State of Johore (Dt. Corp.) 35% Malaysian Development Bank 20% Islamic Development Bank 20% Klockner (RFA) 20% Others 5%
			Loans 72%	7-8 yrs. at approximately 9%

Annex 2

Financing of steel industries expanded in the seventies

taken from James Driscoll "Finance to stay alive in the industrialised countries"

Fixed investments (in US$ billion, current)

	1970	1971	1972	1973	1974	1975	1976
USA	1.7	1.4	1.2	1.4	2.1	3.1	3.2
JAPAN	2.1	3.5	2.4	1.7	2.4	3.1	2.8
EEC	2.3	3.3	3.6	3.9	3.8	4.3	3.9

(in US$ billion, 1975 constant)

	1976	1977	1978
TOTAL USA, JAPAN, EEC	8.6	6.6	5.7

% profits on assets

	1974	1977
US STEEL	19.8	3.3
NIPPON	12.5	8.5
ATH	12.7	4.5
SACILOR	16.0	-18.7
BSC	9.7	- 7.2
ITALSIDER	10.7	3.3

Long-term debts (in US$ billion)

	1970	1976
USA	5.1	7.0
JAPAN	5.2	15.3
EEC	6.6	18.5
TOTAL	16.9	40.8

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UNITED NATIONS INDUSTRIAL
DEVELOPMENT ORGANIZATION

1990 SCENARIOS FOR THE IRON AND STEEL INDUSTRY

- PART TWO -

"PROPOSALS for the SCENARIOS"*

* This study has been translated from an unedited original.

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CONTENTS

A. THE METHODOLOGY USED

1. In the main the methods used are those proposed at the Algiers meeting of the Working Group (3-5 December 1979)(1). They take account of the recommendations made by the Working Group during its Vienna meeting (3-5 September 1980)(2).

They may be represented in the manner shown in diagram 1.

2. The methodology comprises nine steps which are described below.

- 1st step : Analysis of the base and past trends

This step involved the preparation of the document "The World Iron and Steel Industry" (Second study)(3) which re-evaluated the recent development of the iron and steel industry during the crisis, considered new subjects, and outlined the problems involved in future trends.

- 2nd step : "The 1985 picture"(4) (5)

This was discussed by the Working Group at its Vienna meeting, and its function was to constitute a "relay" for the 1990 prospective study. It was used to reduce the uncertainties of projections for the 1980-1990 decade. It was based on relatively reliable information regarding investment projects. It identified a probable deficit of the order of 70 million tonnes between production and steel consumption in the developing countries. It provided an opportunity for identifying the main variables operative during the period 1980-1985 and beyond.

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(1) "Proposals for formulating 1990 Scenarios for the World Iron and Steel Industry derived from a view of 1985", as seen by the UNIDO Secretariat, ID/WG.313/1, 14 November 1979.

(2) "Small expert group meeting on scenarios of the iron and steel industry's development", Vienna, Austria, 3-5 September 1980, UNIDO/PCI Report, 6 October 1980.

(3) UNIDO/ICIS.89, 20 November 1978, French original

(4) Picture for 1985 for the world iron and steel industry (Contribution to the preparation of 1990 scenarios), UNIDO/ICIS.161/Rev.1, 16 July 1980, French original.

(5) New elements for the preparation of 1990 scenarios, Addendum, UNIDO/ICIS.161/Rev.1/Add.1, 13 August 1980, French original

- 3rd step : 1990 iron and steel investment projects in developing countries

As an extension of the 1985 picture, the identification of 1990 projects is covered in "Dossier I" of this document.

Data relating to these projects is involved as an essential "input" in preparing these scenarios. The "output" shows under what conditions they may be implemented, and under what circumstances they will probably be cancelled or extended.

- 4th step : The structural matrices involve a study of relationships between the variables. The iron and steel industry is considered as a system linked upstream and downstream with its physical, economic, social and political environment. External and internal variables structure the iron and steel industry in accordance with varying degrees of interdependence. Some appear to be system driving variables, others are more influenced than influencing. Certain variables are more stable than others.

The iron and steel industry system is thus liable to become destabilized. One structure thus succeeds another. Unfortunately, systematic analyses in this respect are very rare[6]. The constraints, driving variables and graded sequences of the iron and steel industry in the 19th century and beginning of the 20th century are no longer the same as those of the end of the century. An overall structural analysis matrix was therefore constructed, showing current interrelationships and their trends.

Two teams worked independently on the same problem.

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[6] In his "Histoire des techniques", Bertrand Gilles shows how the standard technological systems have been destabilized to give birth to a new structure in the industrial revolution, and how a new contemporaneous system is emerging in the modern age - Encyclopédie de la Pléiade - 1978.

In an initial analysis an Indian team distinguished 64 essential variables[7] and 42 variables were subsequently retained as a function of the consitution of the "dossiers" recommended by the Working Group[8]. The analysis covered the iron and steel industry as such, and also the Indian iron and steel industry.

A Soviet team carried out similar work[9]. This matrix contained 118 variables.

This parallel investigatory experience is interesting in all respects, even if it is not conclusive at the present time. It shows that the same physical and technical universe - the iron and steel industry - may give rise to representations which differ substantially[10]. These differences may be due to the context (market economy versus planned economy) or praxis (dominant experience in design, establishment and operation versus dominant experience in integrated sectoral planning in the national economy). Each of the two representations of variables expresses a situation rationality and logic. What is important is that they express the factors on which the activities and powers of actors in the iron and steel industry are exerted, and on which they will be exerted in the future.

For methodological and practical reasons these structural matrices could not be fully utilized for this study[11]. However, the first lessons were adopted in order to detect the key-variables and trend hypotheses.

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(7) Report on World-wide Study on the Iron and Steel Industry (Contribution to the World Iron and Steel Scenarios up to 1990), October 1980, DASTUR Engineering International GmbH, Consulting Engineers, Düsseldorf.

(8) Supplementary note - November 1980 - ditto.

(9) When this document was drawn up, the study had not been received by UNIDO.

(10) The same applies, for example, to the use of mathematical tools which are by nature objective, such as operational research. If the same problem is dealt with by different analysts, different solutions may be obtained. Everything depends on the problems envisaged at the start.

(11) The matrices will continue to be rectified, and will be mathematically processed in order to detect any indirect relationships between the variables, in addition to the direct relationships.

- 5th and 6th steps : Selection of key-variables and trend hypotheses

It was not possible to select the key-variables by mathematically processing the overall matrices, but their selection was partly based on the latter and partly on an analysis of the "dossiers". These permitted the trend hypotheses to be formulated more directly.

These hypotheses are summarized at the end of each report in the "Summary" section. There are 23 of these in all.

- 7th step : The use of global scenarios

The iron and steel industry system is not an isolated oasis in the world economy. On the contrary, it is largely governed by its social-economic environment, on which it exerts an influence in its turn. However, these influences are not symmetrical. The structural matrices must provide a precise definition of the influence of the external variables on the iron and steel industry internal variables.

It was therefore decided to use the framework of existing major scenarios which allow the ground to be marked out for the development of the external environment.

These global scenarios (for example Interfuturs for the OECD and Leontieff for the United Nations) comprise a coherent series of macro-economic and socio-political hypotheses. There was no point in re-inventing them. They were thus taken as a starting point, supplementing them with more contrasted hypotheses which had not been envisaged and which are justified by the gloominess of the economic stagnation which continues in many industrialized countries.

Account was also taken of new hypotheses for major sectoral scenarios, such as the energy scenario prepared by IIASA which is of considerable interest because of the interdependences shown in the dossiers between steel-making and energy problems.

Finally a selection was made from these external trend hypotheses.

- 8th step : Combination of the hypotheses

Step 6 provided trend hypotheses specific to the iron and steel industry, and step 7 trend hypotheses relating to macro-economic evolution on the one hand and socio-political evolution on the other. These three categories of variables were then combined. The principle of scenario constitution was the coherence of the trend hypotheses combinations.

A reduction in the number of variables to those considered most significant for 1990 still left 13 variables. Each one was considered to have a probability of realization equal to 1 or 0, the number of possible combinations being $2^{13} = 8,192$! In order to reduce the number of scenarios those hypotheses which had a discretionary effect on iron and steel projects in the developing countries were considered, such as the absence of financing.

Another means of elimination was to consider incompatibilities between macro-economic and socio-political hypotheses for the environment and those specific to the iron and steel industry. Among the various scenarios envisaged 7 were finally retained as characterizing typical situations.

- 9th step : The scenarios

These are the result of a combination of hypotheses, that is to say they are not provided beforehand, but are deduced from configurations arising from the combinations.

They take the following forms :

a) a trend scenario,

b) a contrasted scenario: that of prolonged crisis,

c) another contrasted scenario: the divergence of iron and steel industries in the South,

d) a normative scenario: the convergence of iron and steel industries in the South,

e) normative variant: convergence and diversification of iron and steel production in the South,

f) another normative variant: regional self-reliance,

g) a mixed scenario: core areas

At this stage it is necessary to frame these qualitative scenarios within quantitative information in order to establish orders of magnitude for the resultants. These projections could subsequently be developed. However, they are of less interest than an analysis of the significance of the scenarios, and the respective position of the problems which they contain.

Thus the significance of these scenarios with respect to the maintenance of the existing economic order, or to the establishment of a former economic order, has been analysed. Problems, degrees of conflict and cooperation and any negotiating objectives in the various scenarios were reviewed, not to form conclusions, but to open up discussion in the international community regarding the possible, probable and desirable futures and the steps to be taken to ensure that items which can be implemented are as close as possible to those which are desirable.

B. WHAT THE GLOBAL SCENARIOS TEACH US

3. Multiple scenarios - or pseudo-scenarios - have been published in recent years as uncertainties regarding the future have increased, showing the uselessness of conventional forecasting and the need for a prospective approach[12].

A selection was thus made from those which could be of direct interest to the iron and steel industry scenarios. Data and results from the following will be briefly examined : the OECD Interfuturs scenarios, the IIASA energy scenarios, and the United Nations scenarios. Each of these scenarios comprises macro-economic and socio-political hypotheses, each obviously having relationships with the others. In spite of the fact that there was a risk of some simplifications the essential elements can be identified.

[12] In this respect, see Michel Godet's book: Crise de la prévision, essor de la prospective - P.U.F. - l'Economiste - 1977

Macro-economic hypotheses

4. The following table summarizes the macro-economic hypotheses expressed by the projected annual growth rates in the main scenarios considered.

Table 1 : Growth rate of the Gross Domestic Product 1975-2000

	IIASA (1) 1975-2000		Interfuturs (2) (***) 1975-200				Leontieff (3) 1970-2000		UNIDO (4) 1975-2000
	Upper Scenario	Lower Scenario	A	B2	C	D	OEO	NEO (*)	Normative
Industrialized countries	3.9	2.8	4.5	3.8	2.8	3.7	3.9 (**)	3.6	3.7 (**)
Developing countries	5.3	4.0	6.5	6	5.35	6	5.4	6.9	7.3
World	4.2	3.1	5	4.4	3.5	4.3	4.2	4.5	4.5

(*) based on the lower hypothesis of the United Nations population forecast

(**) continuation of past trends for the developing countries

(***) Scenario A : consensus favouring a high rate of growth
B2 : moderate convergent growth scenario
C : North-South rupture scenario
D : protectionist scenario

(1) IIASA : Study on Scenarios for Energy Supply and Demand - to be published.

(2) Interfuturs : Face aux futurs - OECD, 1979, rates deduced from Table 21.

(3) The Future of the World Economy (UN Study) - 1977

(4) UNIDO : The UNIDO World Industry Cooperation in Model
(Provisional document prepared for the IFIP Working Conference on Global Modelling - Dubrovnik, 1-5 September 1980.)

- NEO = New international economic order - Scenario C
- OEO = Old economic order.

5. Comparison of these macro-economic hypotheses suggests the following:

a) <u>The lowest growth rates</u> are those of the IIASA "lower scenario" (3.1% for the world, 2.8% for the industrialized countries and 4% for the developing countries) and those of the OECD "protectionist" scenario (3.1% for the world, the same rate as the IIASA scenario for the industrialized countries, and a higher rate of 5.35% for the developing countries).

b) <u>The highest overall rate</u> is that adopted in the OECD scenario A which favours a high growth (5% for the world); it is also the one with the highest growth rate in the industrialized countries (4.5%), but not in the developing countries (6.5%).

c) The highest growth rates for the developing countries are those of the normative model, UNIDO input-output (7.3%) and the Leontieff scenario of the "New international economic order" (6.9%).

   The growth rates for the industrialized countries (3.7 and 3.6%) are lower than those of the IIASA "upper" scenarios and the Leontieff old economic order (3.9%), and equal to or less than those of the OECD B2 and D scenarios.

   Taken overall the two United Nations scenarios adopt moderately high growth rates (4.5% and 4.2%) which are close to those of the IIASA "upper" scenario, the OECD moderate convergent growth scenario, and the protectionist scenario.

   Thus, the United Nations scenarios are not distinguished by the highest overall growth rates, but by <u>different modes of distribution</u>, favouring the developing nations.

d) The old economic order scenario has rates equal to those of the IIASA "upper" scenario, and for overall growth rates similar to those of the OECD B2 and C scenarios it shows growth rates which are relatively more favourable for developing countries.

6. The range of futures envisaged is therefore a wide one. It ranges from the IIASA "lower" scenario, which for the developed countries is not far from the "zero growth" popularized by the works of the Club of Rome, the implications of which have not yet been thoroughly analysed, by way of the conflict and North-South rupture scenarios and on to the OECD high growth scenario. In the case of the North-South rupture scenario the rates for the industrialized countries are equal to those of the IIASA "lower" scenario, but the growth rate for the developing countries would be equal to that calculated in the IIASA "upper" scenario, and that applicable to a continuation of the existing economic order (Leontieff scenario).

7. The multiplicity of situations which are envisaged in the above nine scenarios must not allow their main differences to be lost sight of. In fact, only two United Nations scenarios (Leontieff NEO and the UNIDO model) are located within the perspective of a new economic order. This is not synonymous with the highest growth. It implies other modes, another distribution of these, and a transfer of resources.

The "upper" and "lower" IIASA scenarios explicitly assume that there are no global changes. The same applies to all the OECD scenarios. They therefore fall within an extension of the old economic order, in accordance with the various modes. Nor do any of these scenarios seem to envisage the effect that the continuation, acceleration or halting of the arms policy will have on growth[13].

Furthermore none of the scenarios envisages the hypothesis in which the existing recession becomes a long-term structural crisis[14]. The IIASA "lower" and OECD North-South rupture scenarios do not go this

(13) The importance of this is not neglected in the Willy Brandt report, for example. See : North-South, A programme for survival. The report of the Independent Commission on International Development issued under the chairmanship of Willy Brandt - Pan Books - 1980.

(14) Hypothesis envisaged by Mr. Samir-Amin in a radical scenario, called Scenario 1984 No.1 after Orwell's political novel "1984". See André Gunder Frank : Réflexions sur la nouvelle crise économique mondiale - Maspero, 1978.

far. Obviously, although this hypothesis is difficult to envisage until the end of the century it is less so for a 1990 horizon. All the same this hypothesis raises the question of the possible repercussions on the developing countries of a continuing recession in the industrialized market economy countries, whilst the repercussions are beginning to make themselves felt in the European countries with a planned economy. Apparently, there is no answer to this question.

The characteristics of the main scenarios are described below :

Interfuturs

8. The purpose of the scenarios was to analyse structural changes which may occur between now and the end of the century in advanced industrial countries and in the relationships between these countries and developing countries.

It is necessary to clarify the strategies and behaviour of the actors who create or disrupt the structural equilibrium at any given time.

9. The scenarios were constructed using the following method :

- Final images, which were established in accordance with the actors' identified projects, were selected, together with theoretical trends of random factors such as technological innovation and/or the discovery of resources.
- Pathways were investigated by working backwards from the final images.
- The inter-relationships between the development hypotheses were taken into account.

Everything was combined in an iterative process in order to obtain coherent final images from the development hypotheses and the existing situation.

10. The scenarios were established by cross-linking "dimensions" and hypotheses. Four dimensions were retained :

The first concerns the nature of the relationships which may be established between the industrialized countries.

The second includes relationships between the advanced industrialized societies and the developing countries, and relationships between the developing countries themselves.

The third is the internal dynamic specific to the industrialized societies themselves.

The fourth covers the internal dynamic specific to the various groups of developing societies.

Two hypotheses were considered highly improbable in regard to the first dimension: "a global balanced interdependence which perfectly expresses the liberal conception of international economic relationships" and complete fragmentation with the formation of self-sufficient and rival blocks. Two median hypotheses were therefore adopted: corporate administration of interests in the industrialized world, or partial abandonment of the freedom of trade, reflecting a situation of conflict.

Four hypotheses were described in regard to the second dimension:

1. A considerable growth in North-South trading.
2. An accentuation of divisions between North and South.
3. Regional fragmentation of the South because of the formation of groups around emerging power centres.
4. Fragmentation of the South in close liaison with the industrialized countries.

Four hypotheses were also considered for the third dimension :

1. Consensus in industrialized societies around the dominant post-war values, favouring economic growth in the traditional meaning of the term.
2. Societies are not the centre of modifications for unanimously accepted values when conflicts between social groups are exacerbated and hold back aspirations.

3. A consensus around slow growth and different content of national income, emerging as a result of rapid changes in values.

4. A strong resumption favours the progressive development of values and generates the "new" growth.

11. Two basic points escaped the above-mentioned dimensions and were incorporated: relative trends in productivity and the impact of Eastern Europe.

With regard to productivity two eventualities were adopted. The first assumes adjustment and convergence of productivities, the second divergence.

Interfuturs did not investigate different hypotheses on the development of Eastern Europe, but endeavoured to adopt credible hypotheses in respect of zone growth, the volume of East-West trade, East-South economic relationships and the attitude of the East in respect of the North-South dialogue.

12. By coherently combining the above-mentioned hypotheses the following scenarios were established:

Scenario A

"Corporate administration of interests and conflicts in industrialized countries, increased freedom of trade, increasingly intense Third World participation in world trading, but with differentiation of developing countries; sustained economic growth in industrialized countries with no rapid modification of values. This scenario assumes that the relative productivities of these countries will converge."

Scenarios B1, B2 and B3

"Identical hypotheses regarding the nature of relationships between industrialized countries, developing countries and between the two groups. On the other hand, the industrialized countries will undergo moderate growth, which differs according to the three variants. In variant B1, changes in value are rapid, and there is a consensus on a slow-down in growth. On the other hand, in the other two variants, there is no appreciable development of unanimously accepted values, and a slow-down in growth is caused more by difficulties in structural adaptation to national and international plans than a conscious wish, as in B1. Whilst the variant B2 assumes a convergence of relative productivities, B3 adopts the hypothesis of divergence, this being linked to social and institutional disparities between the industrialized countries."

Scenario C

"This was introduced to analyse the significance of a North-South confrontation. It is distinguished by : the application of "decoupling" strategies by the majority of developing countries; by an effort towards corporate administration on the part of Northern countries which emphasises the internal liberalisation of their trading; by slower growth with no modification of values in these countries, and by no productivity convergence due to the fact that the large OECD zones are affected differently by the North-South rupture."

Scenario D

"This is distinguished by a fragmentation of the group of industrialized countries and a rise in protectionism, with the emergence of zones of influence centred on three poles, the United States, the European Economic Community and Japan. These zones include regional groups of developing countries (on a continental scale); trade flows and capital develop in a preferential manner within these zones. These hypotheses are coupled with a hypothesis of slower growth, caused in part by the destabilization of patterns of trade. No convergence of productivities is caused by the different impact of the fragmentation process on the major OECD zones ."

The United Nations scenarios

13. Starting from the finding that the growth rates adopted by the United Nations in December 1970 were insufficient to overcome the gap between the developing and industrialized countries (in terms of per capita GDP) which appeared to be of the order 12 to 1, the

main objective of the scenarios prepared under the direction of Professor Leontieff were to bring to light the changes in structure (transfer of resources in particular) needed to reduce the gap by half by the year 2000, and to eliminate it by the year 2050.

14. Two scenarios were therefore considered :

- The scenario of the new economic order (NOE), which fulfils the above-mentioned conditions.

  The rates of growth were established from this requirement, and are therefore affected by external factors. To prevent excessive simplification, two variables were considered which distinguished two population growth hypotheses (i.e. median and low hypotheses of the United Nations Population Division). In practice, they differed very little and reference is always made to the scenario utilizing the low population hypothesis.

- The scenario of the old economic order (OEA). The growth rates are recalculated (and are thus endogenous), using the following three constraints :

  1. Employment in the industrialized countries is assumed to be equal to their manpower resources, this providing more or less full employment.

  2. Investment in countries exporting raw materials is limited by the internal savings capacity and external financing.

  3. Deficits in the balance of payments of all other developing countries are reduced to zero.

In this scenario, there was no reduction of the gap. This may be explained by the absence of substantial growth in investment rates in the developing countries, and by the absence of major growth in exports and in replacing imports.

15. In these scenarios the main limits to growth are more <u>political</u> and <u>institutional</u> than physical. The means of change are massive transfers of "resources" (accrued investments, stabilization of raw material prices, etc.

The UNIDO model (LIDO = Lima Industrial Development Objective)

16. The difference between this global model and other world models (Leontieff and Bariloche) is that it is centred on the implementation of the Lima objective. On the other hand, the Leontieff Model is centred on a reduction in the gap between the developing and industrialized countries (in terms of per capita GDP), while the Bariloche Model is based on maximizing a welfare index.

17. In the current state of the project, it is a four-sector model (agriculture, mining, industry and services - or other headings) relating five regions (Africa, Asia, the Middle East, Latin America and the industrialized countries) by trade or finance flows. Each region is described by a matrix of technical coefficients (with four inputs). Coherence of the whole is ensured by internal or external equilibrium equations.

In order to calculate the growth rates required to implement the Lima objective it is necessary to advance a number of hypotheses in order to obtain equations which can be solved (allowing a single solution). Thus, the following may be mentioned :

- technical coefficients for the year 2000, which are assumed to be known for the industrialized countries;
- the growth rate (GNP) of the industrialized countries is assumed to be almost stable over the period 1979-2000 (1975-1980 : 3.5%, 1980-1990 : 3.7% and 1990-2000 : 3.9%)
- the growth rate in the developing countries is established by means of an iterative calculation as 7.4% over the period 1980-1990. The growth rate for 1990-2000 was then calculated in order to achieve the Lima objective (it is, provisionally, 8%).

The IIASA energy scenarios (*)

18. Compared with the global scenarios, the energy scenarios are of particular interest.

(*) International Institute for Applied Systems Analysis, Laxenburg, Austria.

In fact, a double link between energy and the steel industry was noted: the latter is the main energy consumer, whilst new energy requirements open new markets for the steel industry.

19. The object of the scenarios prepared by the IIASA was to identify the main structural transitions which will affect the economy of the energy sector. The results will be seen further on. However, for an external observer, one of the main results obtained concerns the macro-economic growth rates adopted. In fact, by construction, the GDP growth projections are the result of an iterative process in which their consequences on the demand for energy were investigated.

Energy was considered as the growth permissive factor. Consequently, the growth perspectives are physically subordinate to the energy supply possibility prospects. In accordance with previous analyses (see para 5a) this method provided the IIASA "lower" scenario with the lowest global growth rates of the nine scenarios analysed (3.1%). For the industrialized and developing countries, the "upper" scenario leads to growth rates equal to that of the Leontieff old economic order scenario.

20. This result merits attention.

In fact, the IIASA work could constitute a new version of the Club of Rome work, disputed elsewhere, in respect of growth limits[15]. But this time the limits would be fixed by the energy constraint.

21. The results are obviously a function of the basic hypotheses. These are based on a single projection of the population, and on the absence of basic changes in the social, political and economic structures.

The "lower" scenario has the significance of a trend scenario which cannot be spontaneously achieved, and which implies the application of active governmental policies. The "upper" scenario is frankly normative, and is difficult, but not impossible, to attain.

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(15) D. Meadows: "Limits to growth", Universe Books New York, 1972.

22. Strictly speaking, there is no energy crisis in the two scenarios, but problems in the supply of liquid fuels. A complete transition to other sources of energy takes place over the period 2015-2030.

The demand in industrialized countries would be affected by a conversion to service-dominated economies, and by decoupling transport activities from the remainder of the economy.

As far as the supply is concerned the transition will continue from cheap oil to dear oil from non-conventional sources. Major recourse to non-conventional fossil fuels and coal will take place at the end of this period, around 2030.

The reorganization of energy will have a strong impact on other sectors of the economy. It will have a considerable effect on the iron and steel industry[*].

Other work on the future

23. Other work by futurologists may be useful in constructing the scenarios, at least as elements of thought.

- Peter F. Drucker[16] introduces new concepts and hypotheses which result in an international division of labour perspective, the philosophy of which differs from the perspective approved by United Nations resolutions.

It is estimated that production sharing will be the predominating factor by the end of the century; in this respect we have "neither theories, nor concepts nor measurements", but nevertheless it defies traditional concepts of overseas trade,

(*) From a IIASA graph it may be deduced that the steel manufacturing demand for energy in the "upper" scenario would increase by 60% between 1975 and 1990.

(16) "Managing in turbulent times", Heinemann, London, 1980.

national economies and products, and of all these factors taken together(17).

From now on "transnational integration" will not be the same as "production internationalization". Unlike the latter it does not necessarily require the very extensive multinational enterprise but rather a "transnational confederation" where the multinational company would be a marketing rather than a manufacturing company, and would be capable of making quick changes in direction. The cohesion of the enterprise would depend more on its control of marketing than on its control of capital.

24. Obviously the transposition of this thesis differs according to the sector concerned.

Thus in the petrochemicals industry, the control variable of projects by industrialized countries with a market economy in the Gulf countries does not, in fact, appear to be the financial variable. By nature these projects are orientated towards exporting, and the control variable is obviously marketing.

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(17) The following example illustrates the "production sharing" phenomenon:
"Men's shoes sold in the United States usually start out as the hide of an American cow. As a rule, however, the hide is not tanned in the United States but shipped to a place like Brazil for tanning. Tanning is highly labour-intensive work, for which not enough workers are available in America. The leather is then shipped - perhaps through the intermediary of a Japanese trading company - to the Caribbean. Part of it may be worked up into uppers in the British Virgin Islands, part into soles in Haiti. Then uppers and soles are shipped to islands like Barbados or Jamaica, the products of which have access to Britain and to the European Common Market, and to Puerto Rico, where they are worked up into shoes that enter the United States under the American tariff umbrella.
What are these shoes by origin ? The hide, though the largest single cost element, still constitutes no more than one-quarter of the manufacturer's cost for the shoe. By labour content, these are "imported shoes"; by skill content, they are "American made". Surely these are truly transnational shoes. Anything that has a heavy labour content is processed in developing countries. The raising of the cow, which is a most capital-intensive process, heavily automated, and requiring the greatest skill and advanced management, is done in a developed country that has necessary skills, knowledge, and equipment. The management of the entire process - the design of the shoes, their quality control, and their marketing - is also done entirely in developed countries, where the manpower and the skills needed for these tasks are available".
Peter F. Drucker also takes the example of electronic computers and the triangular relationship between Japan, Algeria and the countries of South-East Asia for the exporting of integrated petrochemicals plants.

The same does not apply in the iron and steel industry, in spite of the requirement for increasing quality which reinforces the future importance of marketing.

The existing division of labour within the iron and steel industry between developing and industrialized countries does not signify "production sharing" of manufactured goods although, in a sense, part of the export of primary and semi-finished products from developing countries correspond with this concept.

25. However, P.F. Drucker's conclusion is not without significance. He estimates that "production sharing" is the best hope - perhaps the only hope - which the majority of developing countries have of surviving the catastrophe of an explosion in the number of young people reaching working age and seeking employment".

The multinationals must provide manufacturing work. This work requires the more sophisticated technology and management obtaining in the industrial countries. This proposal is based on a technological prediction according to which "the modern manufacturing technology of the 20th century, the production line, will have largely disappeared in industrialized countries well before 1995, and will have been replaced by true automation. Only the developing countries will continue to use this technology".

The multinations are the access channel for the markets of the industrialized countries. The author is aware that the greater dependence of developing countries on the new transnationals will steadily create serious political tensions in the developing countries. However, he accepts that "there is no longer a place for sovereignty in an interdependent economic world". He pushes the consequences of the interdependences to its ultimate consequences in the relationships between industrialized and developing countries, with the "production sharing" concept as a basis. The thesis explicity expresses similar positions which are often implicit, and where one of the events will reinforce the existing economic order by transnational integration of developing countries, involving different modes.

26. Robert U. Ayres[18] merely forecasts the trend in iron and steel consumption within the framework of perspectives covering the consumption of foodstuffs, energy and metals. For him, there is no doubt that iron and steel manufacture is a declining industry.

In the United States, in particular, the consumption per unit of gross national product (GNP) should continue to diminish. It was 200 tonnes in 1940, should be 75 tonnes per US$ 1 million in 2000, and possibly 35 tonnes by 2025. An inverse trend is shown in the developing countries, with peaks staggered in time in accordance with the country, as shown in Table 2.

(18) "Uncertain futures - Challenges for Decision-makers" - John Wiley & Sons - 1979.

Table 2

Primary consumption of iron and steel

Country	Intensity (metric tonnes per US$ million GNP)			Intensity (kg per head)			Total annual average (thousands metric tonnes)		
	1972	2000	2025	1972	2000	2025	1972	2000	2025
North America	118	60	35	656	660	665	151,200	191,000	218,000
EEC	163	100	65	477	600	650	116,500	165,000	186,000
Japan	270	80	50	644	610	667	68,900	86,000	95,000
USSR	321	250	90	490	980	850	121,200	300,000	300,000
Brazil	149.7	180	150	76	360	504	7,642	75,000	204,000
China	180	200	125	33	164	348	26,100	193,000	500,000
India (a)	157	200	200	16	39	72	9,227	39,800	108,000
Nigeria	59.5	150	200	9.8	52.5	130	571	6,700	35,000
Sub-total							500,000	1,056,000	1,646,000
World (= sub-total x 1.3)							650,000	1,370,000	2,140,000

(a) Case 2 (median)

Source: "Uncertain futures - Challenges for Decision Makers" by Robert U. Ayres, John Wiley & Sons, 1979

C. TRANSITION ECONOMY ? STRUCTURAL CRISIS ?

27. Questions are being asked regarding the reason for the unusual depth and duration of the steel-making crisis in those industrialized countries with a market economy, and the relative decline in production rates in those industrialized countries with a planned economy.

It is obvious that differing conclusions for the future will be obtained, depending on whether one considers the crisis to be of a cyclical or structural type.

The question is obviously very complex. In fact as an intermediate sector of the conomy, upstream of the capital goods sector, the iron and steel industry is linked to the general economic cycle.

28. This document will not include an in-depth analysis of this cycle. Nevertheless, steel industry scenarios cannot be envisaged without taking account of this factor. Thus, elements have been collected with a view to forming a kind of "dossier", and the purpose at this stage is to stimulate thought.

An attempt will be made to identify some general questions: Is there a structural crisis in the steel industry ? Is there a link between the crisis and the oil "shock"? Is there a relationship between the cycles of the iron and steel industry and that of the capital goods industry ? Are there technological cycles, and are they related to economic cycles ? Do the cycles in developing countries follow the cycles in industrialized countries with market economies ?

Structural crisis or following a long-term cycle ?

29. The alternative is set out in two important studies, one by the International Iron and Steel Institute[19], the other by the Voest Alpine Company at the request of UNIDO[20].

(19) "Causes of the mid-1970's recession in steel demand", IISI, Brussels, May 1980.
(20) G. Meindl: "Contribution to the world iron and steel 1990 scenarios", Linz, Austria, July, 1980.

30. The IISI Study is devoted to an analysis of reasons for the recession in the demand for steel in the mid-seventies, and includes several general statements, the importance of which must be emphasized:

- the iron and steel industry crisis was not started by an increase in the price of oil, to the extent that it has been proved statistically that the point of inflection in the demand for steel came several years before this event. This finding helps towards a greater understanding of industrial dynamics in general. It has been confirmed by other analyses[21] which show that the industrial crisis in all manufactured products came before the energy crisis. As far back as 1969, there was a break in respect of steel and electronic products. This does not mean that, in general, the year 1973 did not mark a structural break with respect to relationships between growth, inflation, unemployment and trends in the balance of payments[22]. However, if no account is taken of the premises of this break, there is a possibility that only the consequences of oil transfers will be seen in the sequence of events.

- far from being a cause of the recession, the industrialization of developing countries will contribute towards absorbing the effects of the crisis.

- the relationship which seems to be so well established between the consumption of steel and the gross national products (steel intensity curve) is called into question to the extent that there appears to be a much closer relationship between steel consumption and investment (i.e. gross fixed capital formation).

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(21) See Gerard Lafay: La mutation de la demande mondiale, in "Spécialisation et adaptation face à la crise: Etats-Unis, Japon, Allemagne, France, Royaume Uni" - Economie Prospective Internationale No. 1, January 1980, La Documentation française

(22) See Alain Cotta: Réflexions sur la grande transition, P.U.F., 1979.

31. The crisis did not seem to be merely cyclical (transitory), but structural (hence durable). It has multiple causes: a breakdown in the international monetary system, anti-cyclic governmental policies, the internationalization of national economies, the impact of the increase in the price of oil, etc.

However, it is caused mainly by the following:

- a change in the energy field: the end of the era of cheap oil, whilst no new dynamic perspectives can be based on the development of alternative energies;
- the trend of investment, whether a reduction in the share of gross fixed capital formation in the gross national product, or changes in the investment structure, increasingly orientated towards improving efficiency or towards economies of energy and manpower, to the detriment of new capacities, etc.

Thus, for the IISI the crisis is structural, but the statement tends to change into a question: is this durable and structural crisis not simply a long-term capital cycle? This question justifies the interest shown further on regarding the interlacing of structures.

32. <u>The contribution of Mr. G. Meindl of the Voest Alpine company</u> is less concerned with investigating the causes of the recession than with investigating future long-term prospects for the world iron and steel industry. Since this original work has not so far been circulated, its main aspects will be summarized.

The analysis was based on iron and steel production statistics over 100 years (i.e. 1880 - 1980) in the United States, the European Economic Community, the USSR, Japan and other countries, mainly developing countries. The corresponding graphs are appended (see Diagrams 2 to 7).

33. In order to interpret past tendencies, the author used a logistic function. The theoretical basis of this statistical choice

is derived from the Kondratieff long-cycle theory, the updating carried out by Jay W. Forrester [(23)] and Bright and Shoeman continuity theory[(24)].

From the point of view of a century of growth in the world iron and steel industry during the period 1970-1980 "the steel crisis does not exist". This is a paradoxical conclusion for those who face the crisis each day, but it is justified in a historical perspective.

34. Theory shows that better long-term forecasting results are obtained by extrapolating on the basis of an envelope which includes the fluctuations.

The application of this curve to American steel production shows a remarkable potential in the long-term future.

A comparison of the growth dynamics of the various steel industries after the mid-sixties shows time-lags and delaying effects.

Considered as a whole, world iron and steel production is similar to a pointed curve, and this can be explained statistically.

The world envelope used for the 1990 projection shows a production of 1,000 million tonnes. This forecast hardly changes, whether a more pessimistic hypothesis with a turning point in 1975 or a more optimistic

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(23) Jay Forrester of the MIT considers that the Kondratieff cycle is attributable to natural fluctuations which the size of productive capital undergoes with respect to the overall size of the economy (i.e. GDP). Forrester maintains that, during long periods of economic development, the investment of capital gradually tends to exceed the demand for products, leading to a long decline in returns on invested capital. In addition, when these net returns are too low, a period of under-investment (and very slow growth) occurs, whilst the value of excess capital stocks depreciates progressively. Finally, a new economic upsurge occurs, caused by various things, often by war, and a new investment cycle starts. This explanation emphasizes fluctuations in fixed capital. It will be noted that it links analyses of the Marxist school between the two world wars in respect of the 1929-33 crisis (see the works of Eugene Varga in particular).

(24) J. E. Bright and M. E. F. Shoeman: "A guide to practical technological forecasting", Englewood Cliffs, N.J. 1973.

hypothesis with a turning point in 1985 is adopted. Obviously, the difference increases between the two hypotheses in the year 2000. However, the purpose is not so much to consider this global projection as to obtain regional forecasts.

35. Consequently Voest Alpine consider that there is no iron and steel industry crisis in this long perspective, but a dynamic process which will continue.

Obviously, the end of the cheap oil era marks the depletion of a "deposit" and the end of a period, but a dynamic upsurge is guaranteed at this present moment, based on the growth of new energy bases to the extent that expenditure devoted to the production of energy should exceed 2 to 5% of the GNP. In fact, this energy upsurge will be reflected in a massive increase in investment in high intensity steel manufacture.

A long-term dynamic iron and steel industry will not encounter major problems in the field of supplies, which will be distinguished by the increasing importance of scrap, the preponderance of coking coal as a reducing agent, other reducing agents (including natural gas) only playing a marginal role, and the interplay which will take place between replaceable materials: steel, cement, plastics and aluminium, as a function of the types of energy available (hydrocarbons in particular).

36. The divergence of positions regarding the crisis arise from evaluations of certain key-elements in order to understand the process.

Agreement is certainly reached on the privileged relationship which exist between gross fixed capital formation on the one hand (investment) and the apparent consumption of steel on the other. On the other hand, the IISI and Voest Alpine develop contradictory opinions on the trend of investments:

- on the trend of the proportion of the gross national product devoted to investments:
  - this is decreasing according to the IISI,
  - this is continuing to increase according to Voest Alpine (in the Federal Republic of Germany, for

example, where the investment part should double between now and the year 2000;

- and on the structure of investments:
  - investments devoted to an extension of production capacities are declining rapidly to the benefit of "modernization" investments geared towards economy of manpower and energy, according to the IISI,
  - investments being increasingly orientated towards the creation of activities and new capacities, according to Voest Alpine and, consequently, are calling on more intensive steel consumption,
  - in the developing countries, the importance of reliable information on capital goods investment projects for steel industry forecasts must be emphasized in passing, because capital goods are the most important of the steel industry's outlets.

The opinions of the IISI and Voest Alpine are also contradictory where the role of energy is concerned:

- the IISI favours an analysis of the recent past, and is conscious to the braking effects resulting from the end of the cheap hydrocarbon era; it does not ignore the existence of openings as result of the application of alternative energy supplies, but remains uncertain until responses become clear;

- on the other hand Voest Alpine accepts that the steel industry will base its renewed vitality on the construction of new energy bases which will mobilize an increasing part of the resources (this part being 2 to 5% of the GNP according to the IIASA), and which will absorb increasing quantities of steel. This hypothesis again raises the question of relationships between the trend of technological progress and economic cycles.

37. Opinions concerning the impact of technical progress on growth show considerable contrasts. Various examples will be examined.

38. Oric Giarini and Henri Loubergé[25] consider that technology has entered a period of decreasing returns.

The revolution marked by the creation of the industrial - technical - scientific complex is becoming saturated. The structure is ageing, and the impulse is lacking. The system had a rapid growth, but today it is running into the above mentioned problems because of its size and success, and into rejection reactions shown by the natural and human environment from which it obtains its means of growth.

This analysis is to be compared with the analysis of D. Landes on the cyclical nature of technological development[26].

39. Opinions differ regarding the existence of the technological cycle itself, and when it is accepted they differ on the direction of its development. Thus, Peter F. Drucker does not accept the existence of a technological cycle.

40. In addition to the cyclical phenomenon, the concept of a scientific and technical revolution has been formulated as an outstanding feature of our civilisation [27][28][29]. The industrial revolution of the modern age is replaced by a scientific and technical revolution from the point of view of principles governing production. The elements are cybernetics, chemistry and a revolution in energy sources. Basically, this is the replacement of the mechanical principle by the automatic principle. In essence, the

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(25) Orio Giarini and H. Loubergé: La civilisation technicienne à la dérive - Dossier "Les rendements décroissants de la technologie" - Dunod, 1979 in English "The diminishing returns of technology" - 1978.

(26) David Landes: "The unbound Prometheus - Technological change and Industrial development in Western Europe from 1970 to the present day", Cambridge University Press, London, 1969.

(27) See R. Richta: La civilisation au carrefour - Anthropos, 1969.

(28) "The scientific and technical revolution and society", (Original Edition) 1973.

(29) Regarding the criterion for the concept of scientific and technical revolution see in particular the works of C. Palloix: L'économie mondiale capitaliste et les firmes multinationales - Maspero, 1975. Benjamin Loriat: Science, technique et capital - Seuil Edition, 1976. Robert Fossaert: La Société - Volume 2: Les structures économiques, Seuil Edition, 1977.

scientific and technical revolution resides in the fact that a new relationship is established between science and industry, and this becomes the decisive productive force. This entry of science into production has the effect of introducing a new rationality into the work process and growth of societies. In general, this thesis leads to an optimistic view of the future linked with social changes in society.

41. Based on this fact of technology based on science other authors[25] came to the opposite conclusion, namely that "we are probably in the descending phase of a long cycle of several decades, distinguished by a slow-down in technical progress".

42. In this respect, the analyses of Gerhard Mensch are resolutely in opposition[30]. He shows statistically that basic innovations always arrive in waves. Stagnation may only be overcome by innovations, and when they appear on the scene, the end of that particular phase is already in sight.

The technological "stalemate"[31] would be a period of reorientation, an intermediate stage between a crisis and an upsurge in which industrial progress would stagnate for a period[32]. The author moves forward boldly and advances the following as a range of possibilities :

1. That only a small part of the innovations which appear in the year 2000 have been introduced during the seventies, hence the tendency to stagnation could not finish during this decade;

2. That approximately two-thirds of all innovations of the second part of the 20th century will occur during the decade around 1989, with a rush beginning in 1984.

(30) Gerhard Mensch : Das technologische Pat-Innovationen überwinden die Depression" - Fischer - November 1977.

(31) The "stalemate" seems to designate a "checkmate" position in a game of chess.

(32) It will be noted that the idea of a "technological stalemate" is compatible with the thesis of Mr. G. Meindl(20) and the "grand transition" idea put forward by Professor Cotta (22).

3. That half of the technologies which would be innovated between now and the end of the century may be considered feasible, while the other half will still be the beginning of the testing stage.

43. These uncertainties reflect the complexity of the relationship between technology and economy. Obviously, the problem is simpler in the 1990 steel industry horizon where a consensus gives rise to the consideration that there will be no disrupting technological innovation (see Dossier IV). This is not true in the 2000 horizon, and this incites a continuation of the analysis by identifying technological progress affecting the industry from the inside, and technological progress affecting it from the outside and transferred from other sectors[33].

44. In order to advance it is thus necessary to confront the facts with theories.

The following were outlined while forming <u>a dossier on recent trends in general growth, growth in the manufacturing, capital goods and steel industries</u>.

A double objective was pursued :

- in the first place, an attempt to determine in a period of recession inter-relationships between economic cycles on a national scale, and in the manufacturing, capital goods and steel-making industries.
- then to evaluate the degree of sensitivity of developing countries to the economic recession at the different levels of analysis.

45. The analysis of cycles was centred on the period 1972-1977 for reasons of statistical limitation. This period needs to be relocated in the long-term cyclic movement.

Graph 8 covers the annual growth in manufacturing added value, and shows this industrial cycle and the period concerned (which has been enclosed in a frame).

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[33] See the works of Miller : Le progrès technologique dans l'industrie sidérurgique - P.U.G., 1976.

46. This industrial cycle is incorporated in an economic growth which coincided with a fall in world economic growth during the period 1972-1977: 3.7% against 5% for the period 1960-1975. The fall is considerable in countries with a market economy: 3.4% against 4.4% in 1960-1975. Industrialized countries maintain a high growth rate of 6.7% which does not fall off with respect to the preceding period. However, sagging does occur during the last three years. The developing countries see their growth decelerate sharply from 6.5% to 3.6%

It will be noted with interest that since that period there is a lag with respect to the Leontieff adjustment scenario, and even with respect to the IIASA "low" scenario.

47. In order to analyse the interlacing of cycles a comparison was made between the following growth rates : national GNP's, manufacturing industries, class 38 covering capital goods, and class 371, covering steel industries.

Table 3 summarizes the results obtained.

Table 3 : Variations in world average growth rates in 1972-1977

	GNP	Industry	Engineering industries, Class 38	Iron and steel industry, Class 371
Industrialized market_economy countries	0	-	0	- -
Industrialized planned economy countries	+ +	+ +	+ +	+
Developing countries	0	0	-	+
World total	3.7%	5%	3.8%	3.7%

N.B. : + + = distinctly higher than the world average
- - = distinctly lower than the world average
+ = higher than the world average
- = lower than the world average
0 = approximately equal to the world average

There are three "readings" of results, first by measurement level, then by groups of countries, then by countries within groups.

48. The growth rates of manufacturing industries in the world are greater than those of the economy.

The growth rates of engineering industries in the world are less than those in industry.

Growth rates of steel-making in the world are a little lower than those in engineering industries.

49. The following growth rates apply to industrialized countries where they market economy : engineering industries (3.7%), industry (3.5%), economy (3.4%) and iron and steel industry (0.6%).

The following growth rates apply to industrialized countries with a planned economy : engineering industry (11.6%), industry (8.7%), economy (6.7%), and iron and steel industry (6.4%).

The following growth rates apply to the developing countries : iron and steel industry (5.6%), industry (5.1%), economy (3.6%), and engineering industry (2.6%).

50. Although the respective positions of the four indicators do not change between industrialized countries with a market economy and those with a planned economy, the same cannot be said of the developing countries.

The steel industry cycle seems relatively strong in these countries, compared with the engineering industries, which are at the bottom.

Consequently, the following questions arise : 1. is the phenomenon general among developing countries, or does the average hide varying behaviours, 2. is the phenomenon durable, since the industrial recession spread to the developing countries in 1979 and 1980 (see graph 8).

51. The absence of comparable statistics for all the developing countries reduces the sample to twenty countries.

This sample permits two different behaviours to be identified among the developing countries.

52. The first group complies with the general average, i.e. the growth rate for steel making exceeds the growth rate in the industrialized countries.

Table 4 : Developing countries where $\Delta(38) < \Delta(371)$
(where Δ is the mean rate of growth over the period 1972-77)

Country	$\Delta 38$	$\Delta 371$
Sri Lanka	-34.72	-13.48
Chile	- 8.49	- 5.64
Zimbabwe	- 1.61	- 0.25
Zambia	- 3.66	2.92
Uruguay	3.73	4.77
Tanzania, United Rep. of	-11.37	5.73
Burma	-19.95	6.65
Dominica	4.62	6.84
India	4.87	8.97
Morocco	8.37	10.12
Peru	5.37	10.91
Zaire	-30.54	13.75

5.6% average for developing countries.

The inequality of steel industry growth rates will be noted.

53. Unlike the average for the developing countries, the steel industry growth rates are less than those for engineering industries in the second group.

Table 5 : Developing countries where $\Delta(38) > \Delta(371)$
(where Δ is the mean rate of growth over the period 1972-77)

Country	$\Delta 38$	$\Delta 371$
Panama	- 3.70	-12.44
Colombia	7.87	- 0.42
Nicaragua	2.88	0.43
Argentina	2.46	0.95
Venezuela	2.42	1.86
Paraguay	8.47	3.84
Egypt	10.24	4.11

5.6% average for developing countries

(contd.)

Table 5 (contd.)

Country	Δ38	Δ371
Singapore	12.63	5.92
Mexico	6.76	6.37
Algeria	11.89	7.65
Malaysia	13.44	8.02
Brazil	10.26	8.98
Ecuador	27.91	19.40
Korea, Rep. of	49.59	40.71

It will be noted that a number of these belong to the semi-industrialized country category. At very high growth rates, they tend to fall into line with the growth rate of industrialized countries.

54. The group where the engineering industry growth rates are higher than the steel industry growth rates include the following countries :

Table 6 : Industrialized countries where $\Delta(38) > \Delta(371)$

Country	Δ38	Δ371
Ireland	4.38	-11.36
Belgium	4.72	- 4.63
Luxembourg	2.52	- 3.83
United Kingdom	0.47	- 2.73
Holland	2.00	- 2.68
Sweden	2.66	- 2.28
Norway	2.30	- 1.40
Fed. Rep. of Germany	2.32	- 1.16
Denmark	1.82	- 0.98
France	3.56	- 0.94
United States	3.66	- 0.54
Israel	6.63	- 0.20
Austria	3.56	0.39
Portugal	4.21	1.41
Japan	4.15	1.76
Greece	4.15	2.31
Hungary	7.23	2.87
USSR	10.76	3.40
Czechoslovakia	8.47	4.71
Dem. Rep. of Germany	7.65	5.73
Yugoslavia	8.41	6.19
Poland	14.04	6.50
Bulgaria	15.68	9.18
Romania	17.63	12.37

Only the following countries are an exception :

Table 7 : Industrialized countries where $\Delta(38) < \Delta(371)$

Country	Δ 38	Δ 371
Australia	-2.08	1.26
Switzerland	-1.87	3.71
Italy	-1.70	4.05
South Africa	-0.98	7.31
Finland	4.31	7.39
Spain	7.73	8.06

55. This analysis suggests the following conclusion: the more the developing countries become industrialized, the more their steel industry cycles and their relationships with the cycles of engineering industries tends to approach those of the industrialized countries with a market economy. The more the recession affects the latter, the less the steel industry in developing countries can remain a favoured oasis (see graphs 9 to 13).

D. THE COMBINATION OF STEEL INDUSTRY HYPOTHESES

56. The "dossiers" in the first part of this study permitted the following hypotheses on the development of the world iron and steel industry to be identified (see "Summary" sections of the dossiers)(*).

1. At least partial continuation of the dissociation phenomenon between steel production and supplies, and multiplication of coastal locations.

2. There are no supply problems in respect of iron ore. But the opening up of mines is a function of the interest shown by steel manufacturers.

3. Scrap will be of ever increasing importance in the steel economy, and its increasing use tends to oppose the opening of new ore mines.

4. The production of ferro-alloys will continue to move towards those owning both ore and energy resources.

(*) These hypotheses are recalled in accordance with the order in which the reports are presented: the order does not imply any priority.

5. The price of energy will continue to grow during the decade, and the struggle to economise in energy will intensify.

6. Coking coal will continue to provide the steel industry with its main form of energy: there are abundant reserves, but its price will tend to follow that of oil.

   The developing countries which, with a few exceptions have no coking coal, may find a substitute in non-exportable natural gas and charcoal.

7. The supply of water in certain regions, and the fight against pollution, will entail additional costs.

8. On the basis of past trends international trade should continue to develop during the decade.

9. The new exporters who have appeared are not likely to upset international trade in steel. It is envisaged that there will be a tendency to reinforce regionalization of international trade.

10. In view of the close link between steel consumption and the gross fixed capital formation, investments devoted to restructuring energy sources will have a considerable impact during the period.

11. Demand will tend towards higher standards of quality, and the link between this demand and existing production capacities will prove difficult in numerous countries.

12. Since scale economies have ceased to be an absolute barrier to entry into the industry, possibilities are provided for the economic creation of small plants using scrap electric furnace, direct reduction - electric furnace or small charcoal furnace - LD convertor type processes.

13. There will be no major technological breakthrough during the eighties, apart from the direct reduction process, but an acceleration in improvements in the standard process, supplemented by the "scrap-electric furnace" process.

14. The iron and steel industry will be drawn towards quality, not only in the production of small quantities of special steels, but in the mass production of quality steels designed to satisfy the increasingly exacting requirements of consumers and converters.

15. In the main, the differentiation of steel industries in the industrialized countries will be a function of the priority and resources allocated to research and development in order to "maintain the rate" of changes in quality.

16. The acceleration of oil research in developing countries permits one to envisage the entry of new countries into steel-making, using the direct reduction method.

17. The movement of the iron and steel industry towards quality requires the acquisition of process know-how, a knowledge of the physical and chemical structure of materials, and a high educational and general technical level.

18. The technological development of the iron and steel industry is liable to lead to modification of traditional trades, thus breaking with Taylorism.

19. High productivity will be linked to the existence of work groups and collective know-how rather than to training of individual workers.

20. In the developing countries, the profitability of steel installations will generally be evaluated in terms of integrating and polarizing poles of development in an industrial system, where know-how generally requires a reorientation of management training programmes.

21. The general increase in the technical level of industry, and the inadequacy of assistance in transferring technologies, will make it more difficult for developing countries to diversify their

production and to extend their range of products.

22. The inequality of development will continue to have an effect during the next ten years. At the present time industrialized countries unilaterally control the design and supply of capital goods and consequently export costs and capacities. The price of capital goods plays the role of a "compensation transfer" to the oil invoice. Industrial arrangements legalise existing force relationships and the resulting imbalances.

23. During the eighties the situation with respect to the financing of steel installations will deteriorate for developing countries which are not oil producers.

Under the joint effect of increased energy and imported equipment costs, and the relatively low price of standard steels, the perspective is towards abandonment or delay in the implementation of projects (see Dossier I).

These are the main hypotheses obtained from an analysis of the "dossiers".

57. An elimination and regrouping of the various hypotheses was then carried out, considering: a) that the scenarios should be centred on developing countries, in accordance with the recommendations of the Working Group, b) that some of the hypotheses were linked in a chain, and could be summarized by the resultant hypothesis, c) that hypotheses would have a minor effect during the next ten years and would make their impact felt during the nineties, d) that the probability of the hypotheses being implemented was in accordance with the projects and actors identified in Dossier I.

Examples of elimination and regrouping will be given. The scrap economy will play an increasing role. However, it is generally of little consequence in developing countries, and is not likely to be a driving variable between now and 1990. It was thus ignored, except when the scenarios were centred on industrial countries, when it was retained.

The rise in the cost of energy is without doubt a driving variable for the iron and steel industry system, and it also affects the price of coking coal. Water and anti-pollution systems increase costs. The increase in equipment prices leads to the abandonment of projects. The relatively low prices of steel products alter the profitability of the industry. In fact, all variables combine in a consistent manner and lead to a regrouped hypothesis: the perspective of deteriorating financing conditions.

58. Finally, this leads to the adoption of the following six hypotheses specific to the steel industry:

H_1 The demand will apply pressure for an improvement in quality and product innovations (regrouping hypotheses 11 and 14 above).

H_2 New steel markets will be opened because of the infrastructures required for the new energy sources (hypotheses 10 and 11).

H_3 Economic transfers will continue to exert themselves by the relative interplay of prices, to the detriment of the iron and steel industry:

- upstream, as a result of negative transfers for energy and capital goods, and in certain cases as a result of positive transfers for ores.
- downstream, as a result of negative transfers to the benefit of metal industries, including capital goods industries (hypotheses 2, 5 6 and 22).

H_4 Financing conditions will continue to deteriorate for the developing countries (hypotheses 22 and 23).

H_5 Due to a voluntarist policy developing countries may have the capacity for assimilating the required steel plant techniques and organization in accordance with their projects (hypotheses 17, 18, 19 and 20).

H_6 Some developing countries will enter the iron and steel industry, or will increase their production capacities by using the direct reduction process and by reducing the size of plants (hypotheses 6, 12, 13 and 16).

59. A combination of these hypotheses, and a combination of them and of the environmental macro-economic and social-political hypotheses, will establish a configuration of the scenarios (see diagram 1).

These combinations will influence the Resultants.

The Resultants are as follows:

- R1 = An increase in investment projects in the developing countries.
- R2 = Progress in the diversification of iron and steel production in the developing countries. The latter is a variant of R1 and involves developing countries which already have an advanced iron and steel industry base.

60. Thus the scenarios are conceived as an input-output process. At the project input there is a "black box" where hypotheses specific to the iron and steel industry and external hypotheses are combined. At the output the resultant situations are obtained for the projects, in accordance with the combinations envisaged.

61. From the point of view of steel industry decision-making centres, the hypotheses do not have the same meaning.

62. Thus the first two hypotheses (product innovations and new energy markets) are constraints.

The driving effect is produced downstream towards the steel industry. The capital goods market is a driving force. The same applies in developing countries if one considers that their industrialization projects will mainly remain dependent on imports, and thus on the technological "pattern" transferred from the industrialized countries[34].

63. On the other hand, the last two hypotheses are decisional variables:

- The increase in the capacity to assimilate technology and organization is within the power of decision of an enterprise or country (the two entities are often the same in developing countries). This does not mean to say that it is easy to achieve, but the solution is obtainable by explicit decisions. The hypothesis thus assumes that developing countries would be capable of overcoming difficulties with an active policy. This hypothesis is more plausible if the choices relate to

(34) See documents prepared for the preparatory global reunion at the first World Consultation on capital goods: ID/WG.324/3 and ID/WG.324/4, Warsaw, 24-28 November 1980.

smaller plants, where management is easier.

- Use of the direct reduction route and the establishment of small enterprises is also a decision which depends on internal authorities, especially if the countries have reducing agents.

64. The other two hypotheses considered correspond to <u>decisional influence variables</u>[35].

Positive and negative economic transfers upstream and downstream are the result of a force relationship between the parties.

The same applies to deteriorations in financing conditions.

Taken overall, relations are currently unbalanced between industrialized and developing countries. However, these relationships are not unilateral and subject to a single authority, and this situation is not inevitable. Even if relationships are subject to constraints at the present time, these can be eliminated.

At country level, a steel enterprise is not a passive piece of the macro-economy. It may influence its environment, and to a certain extent may shape it[36].

Thus, the scope for negotiation is established between constraints which cannot be removed and the decisional variables. Reinforcement of the decisional variables may be facilitated by international cooperation.

65. A scenario is prepared in accordance with the following convention: when a hypothesis complies with the above-mentioned tendencies it will be shown as 1. An opposing hypothesis will be written as 0. If an association of hypotheses leads to the

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(35) The classification adopted is the one used by Mr. Tennière Buchot in his work: Le Modèle "Popole". Une tentative d'analyse du système "eau" dans une agence financière de bassin - Futuribles, February/March 1973.

(36) This representation follows the line of thought of Professor F. Perroux, as expressed in the work: Unités actives et mathématiques modernes - Révision de la théorie de l'équilibre économique général, Dunod, 1975

conclusion that they favour an increase in steel projects in developing countries, R will be written as 1. Otherwise, it will be written as R = 0.

For example, in the sense of the hypotheses described, a "trend" scenario will be written in its simplest form as follows:

H1	H2	H3	H4	R1
1	1	1	1	0

and in its developed form as follows:

H1	H2	H3	H4	H6	R1	H5	R2
1	1	1	1	1	0	0	0

Current trends do not favour the implementation of projects.

A contrasted "normative" scenario, implying a reversal of tendencies blocking projects in developing countries, will be written in its simple form as follows:

H1	H2	H3	H4	R1
1	1	0	0	1

and in its developed form as follows:

H1	H2	H3	H4	H6	R1	H5	R2
1	1	0	0	1	1	1	1

66. It will be noted that the hypotheses may also be classified as a function of their duration in the past, either long or short.

Thus hypotheses 1, 3, 5 and 6 are linked to a more long-term trend than hypotheses 2 and 4, which are more linked to the recession and recent crises.

67. However, combinations will only include hypotheses <u>specific</u> to the iron and steel industry. The scenarios will only take shape if the hypotheses are coherent with the environmental hypotheses.

E. DEFINING THE SCENARIOS

68. The following socio-political hypotheses may be derived from the overall scenarios:

a. The existing economic order is maintained;

b. A new international economic order will gradually be established;

c. The situation of the developing countries will diverge;

d. The situation of the developing countries will converge.

Combination of these four hypotheses leaves only three possibilities. Within the framework of the existing economic order the convergence of the developing countries is excluded, otherwise inequalities could only increase.

69. The macro-economic hypotheses expressed by the growth rates could be multiplied. This would have no great significance. On the other hand, in the "technique" for preparing the scenarios they are only introduced when the coherence of the qualitative scenarios is established. We shall limit ourselves to noting their logic with the latter. Thus, one may limit the hypotheses to three economic growth rates in developing countries:

- a gross domestic product growth rate of the order of 7%, corresponding to the United Nations New International Economic Order scenarios.

- a growth rate of 5.4% corresponding to the Leontieff maintenance of the old economic order scenario, the OECD North-South break scenario and the IIASA "high" scenario.

- a crisis growth rate of 3%, less than all the scenarios considered (including the IIASA "low" scenario), which increases and thus extends the sag measured between 1978 and 1980 (see para. 46).

70. The corresponding growth rates for the iron and steel industry in the developing countries have been estimated as 9%, 6.5% and 4.5% respectively. These rates are not "inevitable" or linked by an inexorable curve to the gross domestic product growth. They will

depend mainly on development projects in the capital goods industries. The lack of precise information and the uncertainty currently existing in numerous developing countries regarding the direction to take in this domain makes any relaxation of these rates by regions illusory, especially as no measurements are available on steel intensity curves for countries with incomes of less than US$ 400 (1963 value). These overall rates were therefore provisionally adopted in order to show the trend in demand, and the situation which would arise in respect of the steel supply in the developing countries.

71. The supply seems to be the least uncertain part of the projections. Obviously, there is a link between the supply level and the demand. However, this link appears to be strong in contrasted situations (e.g. prolonged structural crisis). In other situations, it appeared that the majority of scenarios considered below were compatible with the steel demand growth rates in the 6.5% - 9% range. The steel supply has its own inertia and drive, linked to the degree of commitment to projects. In the majority of developing countries, the question of balancing demand and production does not arise: in 1979 the global deficit was 25 million tonnes of steel. Consequently, in general the demand-supply link does not operate in the same way as in the industrialized countries with a market economy.

72. Thus, it is combinations between socio-political hypotheses and hypotheses specific to the iron and steel industry, rather than macro-economic hypotheses, which establish the configuration of the scenarios.

73. The following table summarizes the <u>definition of the scenarios</u> (Table 8).

74. In the same way as the OECD scenarios, these scenarios adopt certain "dimensions" deriving from the hypotheses.

As for the OECD, and for the same reason, two extreme dimensions were therefore excluded: "the global balanced interdependence which clearly shows the "liberal" conception of international economic relationships", and "complete fragmentation with the formation of self-sufficient and rival blocks"(37).

(37) Interfuturs, page 82 - French edition

Table 8 : Definition of the iron and steel scenarios

Cooperation ← → Conflict

new economic order

old economic order

Development of steel industries in the South	Convergence		Divergence	
North-South and South-South relationships	North-South corporate administration	Fragmentation between the poles		
		South-South corporate administration	Limited cooperation from the South	No cooperation
Maintenance of structure ascendancy. Integration by the North	M			T T1
Regional integration of the South		R	T2	
Rebalancing of North-South relationships	N N1			

75. The world steel situation excludes liberal integralism when the crisis causes the EEC to intervene in markets, and when the threat of a protectionist backlash is seen in other countries.

The formation of a "South" self-sufficient block[38] also appears to be unrealistic. One only has to see the interpenetration of "North" and "South" interests in steel projects in developing countries to conclude that a rupture scenario is not very probable in this particular case.

[38] For convenience of presentation we shall talk of "North" and "South", conscious of the lack of precision, and to a certain extent the fiction of the terminology in use in the West. The "North" is not homogeneous. It includes at least the "West", "East" and "South", and although it has common interests, it no longer constitutes a homogeneous whole. When defining the scenarios, we shall gradually move away from this terminology.

76. As for the OECD, "two mean hypotheses, reflecting two possible types of outcome to the problems posed by rebalancing international relationships" were retained. However, whilst the OECD only envisaged these dimensions "within the industrialized world" they were investigated in respect of relationships between the industrialized world and developing countries, and in respect of relationships between the latter.

77. Thus, it is no longer only a question of "corporate administration of world interests developed by the larger countries or the United States, the EEC and Japan ... but corporate administration which assumes a relatively high degree of opening, and a certain level of economic stability".

"Corporate administration" means administration of industrialized and developing world interests. This shift in definition is precisely the gap separating the old economic order and the New International Economic Order (NIEO) to be "invented"[39]. It is therefore in accordance with the mandate received by the United Nations to investigate these new channels.

78. A fragmentation between poles was also considered, rather than a break between blocks, like the OECD.

79. In the case of the iron and steel industry it was considered as the backcloth that the policy of industrial countries with a market economy would tend towards corporate administration in order to eliminate or reduce conflicts between them. The creation of the OECD Steel Committee does tend precisely towards this objective. This condition of "North-North" relationships - or to be more precise "West-West" relationships - is maintained in all of the scenarios except that of "prolonged crisis", where it is assumed that Western solidarity will not hold out. The de-regulation of markets[40] combines with an extension of the crisis in developing countries. This is an extreme hypothesis, but it is not absurd, as shown by previous analyses regarding the sensitivity of developing countries to a crisis.

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(39) Using the expression of the UNESCO Director General, Mr. Amadou Mahtar M'Bow. See: Le Monde en devenir - réflexions sur le Nouvel Ordre Economique international - UNESCO, Paris 1976.

(40) According to the expression of the EEC General Commissioner, Mr. Davignon, leading to an "apocalyptic scenario".

80. Relationships between developing countries may range from an absence of cooperation - which is broadly the existing situation - to limited cooperation (e.g. the Arab oil-producing countries finance installations in other Arab or Islamic countries) to a "South-South" corporate administration at different levels: sub-regional, regional or intercontinental.

These two "dimensions" intersect with those of other aspects in "North-South" international relationships.

81. The third dimension relates to maintenance of the ascendancy of the structure of the North over the South, and the integration of the South by the North. This ascendancy of structure is brought about through financing, markets, capital goods and technology.

82. The fourth dimension relates to regional integration within developing countries. The dynamic of these integrations may vary between the poles of cooperation and conflict with the "North", and in accordance with differentiations between the "West" and "East". Thus, the industrialization policy adopted by the African Heads of State in Lagos (*) is a reaction to setbacks at the major international conferences, including UNIDO III. The orientation towards "self-reliance", and in certain cases self-sufficiency, is a sign of disenchantment with international relationships, and a desire to be able to rely on their own strength rather than on others.

83. The fifth dimension is the rebalancing of "North-South" relationships in the sector, as outlined in the suggested negotiating objectives in the "dossiers".

84. The crossing of these three dimensions with either a fragmentation between poles or corporate administration establishes scenarios with differing degrees of conflict or cooperation in the inseparable conflict-cooperation mixture[41]. A movement from right to left in

(*) Organization of African Unity - Lagos Plan of Action, Lagos, Nigeria, 28/29 April 1980.

[41] Regarding conflict-cooperation, see the works of F. Perroux: Pouvoir et économie, Bordas, 1973.

Table 8 corresponds with a movement from the pole of conflict to the pole of cooperation.

Thus, the following scenarios may be established:

85. Scenario T or "trend" scenario.

Corporate administration of interests and conflicts within industrialized countries with a market economy; continuation of iron and steel trade intensification, maintenance of the structural ascendancy of industrialized countries over developing countries, little or no cooperation between developing countries, differentiation of iron and steel industries according to the various developing countries, and divergence of development between them, and overall implementation of 1990 projects less than specified, owing to financing difficulties and the fact that progress in diversifying steel products is limited to a few developing countries.

The scenario thus takes the following form:

H1	H2	H3	H4	H6	R1	H5	R2
1	1	1	1	1	0	0	0

86. Scenario T1 or "crisis" scenario

The current recession drifts into a prolonged structural crisis, which also has a direct effect on developing countries, the corporate administration of Western countries does not withstand the crisis, conflicts become sharper, there is an increase in unused production capacity, crisis rationalization affects installed steel capacities more severely than the existing restructuring, public opinion in Western countries, where unemployment continues to increase, is opposed to all export of capital for steel plants in other regions, protectionism develops, international trade diminishes, numerous projects in the developing countries are cancelled, due to lack of financing and projects involving metallurgical industries, only a few oil States continue with their projects, and divergences between developing countries are limited to these exceptions.

The effect of these events is a drastic drop in programmed production capacities in the developing countries.

The scenario thus takes the following form:

H1	H2	H3	H4	H6	R1	H5	R2
1	0	1	1	0	0	0	0

87. Scenario T2, of limited "South-South" cooperation

The hypotheses are identical to T, namely the maintenance of existing trends, excluding a catastrophic crisis which exacerbates conflicts.

Within this context a T2 variant is limited cooperation between the South countries, based on the possibilities of oil countries; for example Gulf countries with the Middle East and African Arab States, Mexico and Venezuela with the Latin American and Caribbean States.

This limited cooperation improves the results for projects in developing countries compared with the trend scenario, but cases of implementation are less than the projects specified.

Consequently, the scenario may be written as follows:

H1	H2	H3	H4	H6	R1	R2
1	1	1	1	1	0	0

88. Scenario R, of general "South-South" cooperation.

This scenario is characterized by: the persistence of industrialized countries in maintaining international relationships within the framework of the existing economic order, the reaction of developing countries in modifying this by means of a policy of self-reliance, the replacement of imports from industrialized countries, the increase in trade between developing countries, mobilization of self-financing capabilities and technological and human resources, without leading to a break with the "North", whilst the links are stretched to breaking point with the latter, leading to cancellation or delay in certain projects.

Maintenance of these projects is thus governed by the possibility of replacement with "Southern" parties, but the possibility of financing, and in particular the possibility of gaining industrial know-how, is limited. The capital goods industry of the developing countries is stimulated, but is not called on to meet the requirements. As a secondary consequence, although steel industry convergences increase and capital goods industry divergences between developing countries increase, very few of them (i.e. 8) are currently in a condition to contribute substantially to steel equipment, and it may therefore be difficult to resume numerous projects abandoned by the "North" partners. Technological and industrial know-how capabilities are unevenly distributed between Asia, Africa and Latin America, and the possibilities of regional self-reliance are unequal between these continents; Africa in particular needs inter-continental solidarity in this case. The scenario tends towards a convergence of the South, but its relationships imply South-South corporate administration in the steel-making sector.

An additional difficulty arises from the fact that investments in manufacturing sectors, and in particular in the capital goods industry, require high-grade steels which the "South" cannot reasonably be expected to produce in sufficient quantity between now and 1990. Technological dependance makes the importing of these products unavoidable. Consequently, developing countries with an export capacity in long products (and even flat products) should be able to continue exporting to the industrialized countries, even if only by way of compensation agreements or to obtain essential foreign currency. This inter-relationship will thus not permit exclusive international trading between the developing countries.

All of these objective difficulties lead finally to resultants where the scenario R production capacities are less than the projects specified.

Scenario R may thus be written in the following form:

H1	H2	H3*	H4*	H5	H6	P1
1	1	0	0	0	1	0

* on the hypothesis that developing countries are likely to rearrange economic transfers and financing between themselves.

89. Scenario N is "normative".

Relationships between the industrialized and developing countries are rebalanced, a certain degree of corporate administration is established, the reciprocal publication of information on projects is shown by a mechanism of frequent consultations which leads to a form of target planning, the economic terms of international trading for iron and steel industries in the developing countries is subject to constant analysis and corrective measures, the conditions of access to financing are improved, the unilateral power of technical assistance is subject to re-evaluation, and its content is more appropriate to the requirements of iron and steel projects in developing countries, the latter are envisaged as true poles of development, the demand for steel may thus be expressed, with greater certainty, as a function of the improved link with downstream industrial projects, these require increasing quantities of high-grade steels which still have to be imported, international trading increases, iron and steel production in developing countries continues to be directed mainly towards their domestic markets, exports of these products do not disrupt western markets, and cooperation is also effected at three levels: to facilitate the entry or advancement of developing countries in the manufacture of more sophisticated steel products, to facilitate research and development in the direct reduction process, and in particular to facilitate the attainment of higher market shares for the installations. Under these conditions, specified projects may be implemented, and even exceeded, in 1990.

Scenario N may thus be written as follows:

H1	H2	H3	H4	H5	H6	R1	R2
1	1	0	0	1	1	1	1

Scenario N1 is a simple normative variant of N.

It implies that developing countries which currently have a steel industry base will advance in the management and diversification of their production. Since the degree of dependance in respect of importing high-quality products will remain at a high level during the period, the scenario N1 does not have the potential to create conflicts attributable to competition with industrialized countries.

90. Scenario M is a "mixed" scenario based on the geo-political concept of "core areas".

The concept of a "core area"[42] comes from the theory of self-centred development[43]. This theory may be summarized as follows: A certain population and density is indispensable for the development of complete industrial complexes. In the economic world, the numbers define the "core areas".

At the present time, there are multi-national "core areas": the United States and Canada, Western Europe, the Soviet Union and Eastern Europe, and one national zone, Japan. Potential "core systems" are China, India, Java and Indonesia, Brazil, Nigeria, Mexico, Vietnam, the Philippines, Egypt, Argentina and the multi-national formation around Lake Victoria in Afria[44].

On this assumption, the world economy is developing in the direction of a "multi-centred system". The advantages of mass production within these zones would surpass the advantages of an efficient transport system. The motive force behind this development is the extraordinary increase in population.

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(42) Used by Mr. G. Meindl in his "Contribution to the World Iron and Steel 1990 Scenarios", July, 1980.

(43) See in particular "Intereconomics" 3/4, 1978: Demography - Implications of autocentric development.

(44) Mr. G. Meindl - doc. cit.

The resultant scenario M is "mixed", because it appears at the cross-roads between the fragmentation of poles and an administration involving the "South", "West" and "East", and the formation of homogeneous groupings (West, East and South) or heterogeneous groupings (West and South), where relationships may: confirm the degrees of domination or re-establish a balance, or facilitate South-South integration, or integration of the South by the "North": the scenario implies a growth in trade within each of the centres, and a reduction in international trade, e.g. self-sufficiency in the United States and Canada[45]. For each of them, it requires an adequate capability in industrial management, and a given capital goods production level. With regard to the limitations which it introduces it is similar to scenario R.

The "core area" population criteria introduce a selection factor into projects in developing countries, and results may be ambiguous. On the one hand, they imply the input of new producers, and on the other hand they limit them. The resulting convergence of steel industries in developing countries would thus be lower than in the case of the "normative" scenario N. It is similar to scenario T in the sense that a multi-centred system would be the culmination of current trends.

It does not prejudge the solutions - drawn towards the existing economic order or towards a new economic order - given to hypotheses which apply economic transfer and financing blocking variables to projects. Geopolitics cannot remove these problems.

Consequently, the scenario M formula reflects its ambiguities and interest:

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(45) Vigorous progress and brilliant prospects for the American iron and steel industry are envisaged for the future by numerous analysts, in spite of current events. See for example: Wolfgang H. Philipp, 108th AIME annual meeting in New Orleans - Panel discussion on February 19 1979: Five years after Lima and the LDC's programme for 500 million tonnes annual steel capacity by the year 2000. Where does it stand, and what does it mean ?

	H1	H2	H3	H4	H5	H6	R1	R0
existing economic order	1	1	1	1	0	1	0	0
new economic order	1	1	0	0	1	1	1	1

The effect on projects must therefore be positive or negative, depending on the content of the "mix".

91. Thus, scenarios may be classified in the following order in respect of their influence on the sensitivity of project implementation.

Scenarios: N1 > N > M > R > T2 > T1

Resultants:
1 = R1 = 0
⟵ 1 = R2 = 0 ⟶

92. Defining these scenarios must not lead to the impression of inflexible barriers between them. Their trajectories may permit shifts from one to another to be envisaged. Thus, the projected trend (scenario T) may degenerate into a deep crisis (scenario T1) or into a partial recession in the "South" (scenario T2). It may cause a more rigid outlook in the "South" following setbacks in international negotiations (scenario R), these taking the form of regional integration or the formation of "core areas" (scenario M). This may integrate elements of a tendency towards the old economic order (scenarios T, T1 and T2) and elements of a trend towards a new economic order (scenario N). The regional self-reliance scenarios (scenario R) may belong to the existing economic order to which they are attached, or may be a transition towards a new order.

93. Scenarios may be classified along traditional lines, that is to say in accordance with three concepts of the future world,[46] conservative, reformist or radical. The radical hypothesis is the prolonged crisis scenario T1. The conservative hypothesis is

(46) See Sam Cole, Jay Gershuny and Ian Mites: Scénarios du développement mondial - Futuribles, May/June, 1978, and the interpretation of these scenarios for the problem of "transferts des industries et dépendance technologique dans les pays en développement" - P.F. Gonod - No. 23 of Mondes en Développement 1979, devoted to "Externalités et Développement - Stratégie des ressources mondiales".

included in all scenarios which perpetuate the existing economic order. The reformist hypothesis is present in scenario N, and to a certain extent in M. However, in theory and in practice, the drafting of a new economic order remains an open question, in spite of the considerable amount of literature devoted to this subject[47].

F. THE IRON AND STEEL INDUSTRY SCENARIOS IN ORDERS OF MAGNITUDE

94. A dual calculation was effected in order to provide a glimpse of the possible orders of magnitude of steel supply and demand in the developing countries under the above mentioned scenarios:

- in the first instance, the volume of demand per region was estimated in accordance with the three steel growth hypotheses considered above.
- then, for each of the projects listed in Dossier I, the capacities specified, constraints, decisional variables and decisional influence were listed and evaluated with a view to ascertaining how they were likely to affect projects within the context of these scenarios (*).

95. The calculation includes the following combinations:

Macro-economic hypotheses of steel industry growth in developing countries	Type of Scenario
Ha = 4%	T1 (crisis) not very compatible with the other scenarios
Hb = 6.5% Hc = 9%	not incompatible with the other scenarios

(47) On the conceptual plane, see Richard A. Falk: Reforming World Order: Zones of consciousness and domains of action in Planning alternative World futures, edited by Louis René Beres and Harry R. Tag, Praeger Publishers, 1975.

(*) In order not to overload this already voluminous document, these analysing documents have not been reproduced.

Apart from the crisis scenario T1, the other scenarios will thus have two demand estimates within the 6.5% and 9% range.

96. The calculation was reduced to three typical scenarios: T1 (crisis), T (trend) and N (normative), and it was assumed that the values of T2 and R would fall between T1 and T, and that the value of M would fall between T and N, N1 only being a qualitative variant of N.

97. Two production level hypotheses were also considered for total installed capacities in 1990, 70% and 85%, these constituting relatively high objectives for the numerous developing countries, in particular the new producers.

98. In order to correspond with geopolitical realities of cooperation in the Third World, two groups were formulated: Africa south of the Sahara, and North Africa/Middle East countries.

99. The new installed capacities between now and 1990 were estimated for the various scenarios (see table 9 below).

100. The balance of demand and supply on the three demand growth rate hypotheses, the three scenarios adopted and the two market rate hypotheses are summarized in table 10.

101. In all cases considered, the demand-supply balance for developing countries taken as a whole shows a deficit.

The minimum deficit is seen in the normative scenario N with a steel demand growth rate of 6.5% and a production level of 85%. The rate of coverage of supplies by production is 95%. Latin America shows a net export surplus of more than 9 million tonnes, and the zone in Africa south of the Sahara shows a few exports.

The maximum deficit is noted for the trend scenario T with a steel demand growth rate of 9% and a production level of 70%. The rate of coverage of supplies by production is 47.6%. All regions are net importers.

Table 9

New production capacities in 1990

In thousands tonnes	Scenario T1 (crisis)	Trend scenario T	Normative scenario N
Africa south of the Sahara	4.0	7.0	8.0
North Africa, Middle East	11.5	14.0	19.5
Asia	23.0	30.0	37.0
Latin America	29.0	35.0	55.0
Total	67.5	86.0	117.5

Table 10

Steel industry 1990 demand/supply balance in the developing countries

Type of scenario	Demand growth rate	Demand (millions tonnes)	1990 production capacity	Production level 70%	Production level 85%	Demand/supply balance	
						Production level 70% (3 - 5)	Production level 85% (3 - 6)
T1 (crisis)	4.5%						
Africa south of the Sahara		4.1	5.0	3.0	4.2	- 1.1	+ 0.1
North Africa, Middle East		21.1	17.2	12.0	14.6	- 9.1	- 6.5
Asia		55.1	50.0	35.0	42.5	-20.1	-12.6
Latin America		52.3	61.0	42.7	51.8	- 9.6	- 0.5
Total for developing countries		132.6	133.2	92.8	113.1	-39.8	-19.5
T (trend)	6.5%						
Africa south of the Sahara		5.0	8.0	5.6	6.8	+ 0.6	+ 1.8
North Africa, Middle East		26.0	19.7	13.7	15.8	-12.3	-10.2
Asia		68.0	57.0	34.9	48.5	-33.1	-19.5
Latin America		64.6	67.0	46.9	56.9	-17.7	- 7.7
Total for developing countries		163.6	151.7	101.1	128.0	-62.6	-35.6

(cont'd)

Table 10 (cont'd)

Type of scenario	Demand growth rate	Demand (millions tonnes)	1990 production capacity	Production level 70%	Production level 85%	Demand/supply balance: Production level 70% (3 - 5)	Demand/supply balance: Production level 85% (3 - 6)
T	9.0%						
Africa south of the Sahara		6.4	8.0	5.6	6.8	- 0.8	+ 0.4
North Africa Middle East		33.5	19.7	13.7	15.8	-19.8	-17.7
Asia		87.7	57.0	34.9	48.5	-52.8	-39.2
Latin America		83.3	67.0	46.9	56.9	-26.4	-26.4
Total for developing countries		210.9	151.7	100.4	128.0	-109.8	-82.9
N (normative)	6.5%						
Africa south of the Sahara		5.0	9.0	6.3	7.6	+ 1.3	+ 2.6
North Africa Middle East		26.0	24.2	16.9	20.5	- 9.1	- 5.5
Asia		68.0	64.0	44.8	54.4	-23.2	-13.6
Latin America		64.6	87.0	60.9	73.9	- 3.7	9.3
Total for developing countries		163.6	184.2	128.9	156.4	-34.4	- 7.2
N (normative)	9.0%						
Africa south of the Sahara		6.4	9.0	6.3	7.6	- 0.1	+ 1.2
North Africa Middle East		33.5	24.2	16.9	20.5	-16.6	-13.0
Asia		87.7	64.0	44.8	54.4	-42.9	-33.3
Latin America		83.3	87.0	60.9	73.9	-22.4	- 9.4
Total for developing countries		210.9	184.2	128.9	156.4	-82.0	-54.1

102. The increasing order of deficits as a function of the combination of scenarios, demand growth rates and market rates is as follows:

[N Δ 6.5% 85%] < [T1 Δ 4.5% 85%] < [N Δ 6.5% 70%]
< [T Δ 6.5% 85%] < [T1 Δ 4.5% 70%] < [N Δ 9% 85%]
< [T Δ 6.5% 70%] < [N Δ 9% 70%]
< [T Δ 9% 85%] < [T Δ 9% 70%]

103. Compared with the 1979 deficit in the developing countries (about 25 million tonnes), the deficit would be less only in the following combinations:

[N Δ 6.5% 85%] [T1 Δ 4.5% 85%]

104. For other combinations, the deficit would represent between 28% and 88% of international trade in steel products for the year 1977, during which imports from developing countries represented 30% of world imports and 2.6% of exports.

In this hypothesis there could well be a disruption of the world market, not as forecast a few years ago from competition from new producers but by new markets being opened for installed producers.

105. Thus, the centre of gravity of consideration will move towards perspectives of growth in steel demand in the downstream sectors in developing countries.

The problem does not involve financing the steel industry in these countries and the removal of constraints, but industrialization of the engineering, durable consumer goods and capital goods sectors. Steel demand rates of 6.5% and 9% show the potential requirement. It is a question of converting these potentialities into realities.

106. Without doubt, the "crisis" scenario is relatively optimistic in regard to the trend in demand which could fall below a rate of 4.5%.

If we consider production capacities as data - they were established for each project as a function of their sensitivity - in order to achieve an accountable balance between supply and demand in the T1 scenario with a production level of 85% the demand would be balanced with a growth of 2.8%, and at a production level of 70% with a growth of 0.85%, i.e. practically zero.

107. The annual growth rates of production capacities in scenarios T1, T and N are high. However they are not unrealistic, since under the conditions specified previously 7.3%, 8.7% and 10.9% are not outside the range.

However, the use of installed capacities seems to be a fundamental variable. The deficit with respect to an identical demand is practically the same in scenario (N Δ 6.6% 70%) as in the scenario (T Δ 6.5% 85%), although in the latter, the installed capacity is less than 32.5 million tonnes. For this reason exceptional importance is attached to an improvement in operations and cooperation between parties from the design to implementation and entry into full production (see Dossier VI).

108. Deficits measured in the scenarios are net balances. Obviously, imports from developing countries should exceed these estimates. In fact, whichever scenario is envisaged, there appears to be an unavoidable constraint, i.e. the importing of "top of the range" steels which developing countries are incapable of producing, at least in sufficient quantity.

Using statistics, it is difficult to evaluate the level of trade in these products(*). A partial analysis of the year 1977 shows that

(*) In order to achieve this it is necessary to use 5-digit statistical groups of international headings, and there is not always an accountable balance between imports and exports, data exists in value but not in weight, etc.

overall developing countries imported more than 5.5 million tonnes of flat products and 1.450 million tonnes of pipes, tubes and fittings, whilst they only exported 0.8 and 0.7 million tonnes respectively. To these it would be necessary to add special steels imported in various forms.

Thus, although Third World exports do not appear capable of disrupting the equilibrium because of internal requirements, it is nevertheless necessary to envisage a stream of exports from these countries, even though they are a partial compensation for the importing of sophisticated products which their industrialization calls for.

In fact, in ten years, one can hardly visualise a "new growth" - in the words of the OECD - mobilizing other values in society, and capable of achieving other methods of industrialization based on simpler techniques(48).

More probably the inescapable deficit in capital goods in developing countries, inevitably leading to imports, will have the effect of introducing models of industrialization which comply with Western standards. Modification of these models implies a series of political and technical conditions in the developing countries.

Consequently, the question arises as to where to export, even if relatively limited quantities are involved.

109. It will be remembered that in 1977, of 37.6 million tonnes of steel products imported by the developing countries, more than 33 million tonnes came from industrialized countries with a market economy, 2.3 million tonnes from industrialized countries with a planned economy, and 2 million tonnes from trade between developing countries. Of 3.2 million tonnes of exports from developing countries, only 1.2 million tonnes were exported to industrialized countries with a market economy, and a very small quantity, 0.06 million tonnes, to industrialized countries with a planned economy.

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(48) Essential problem posed in the document "La technologie au service du développement", UNIDO, ID/WG.324/4 19 September 1980.

110. In the current position of the iron and steel industries in countries with a market economy, it is very difficult to formulate a long-term perspective(49). Here, the supply must closely adapt itself to the demand, and the general uncertainty makes this a random process. Projects are only formulated as a function of market prospects, and the strategy of the parties is changeable in this great international activity(*).

111. There is a certain amount of uncertainty also regarding the prospects of industrialized countries with a planned economy.

An evaluation of consumer requirements in the CMEA in 1990 has been revised in the direction of a relative decline compared with past trends.

No official information is available regarding production plans. A linear extrapolation of results for the period 1970-1975 - which are higher than those for the 1970-1980 trend - would leave a deficit of the order of 25 million tonnes in respect of consumption, and a self-sufficiency rate of 76% (see table 11).

Table 11: Assessment of net deficit in steel products for CMEA countries in 1985 and 1990

Year	Consumption(1)	Production(2)	Net deficit (in millions of tonnes of crude steel)(3)
1985	276.0	266.3	- 9.7
1990	328.2	303.3	-24.9

(1) The consumption figures are taken from the document "Projection 90", IISI/ECON/100, 1980

(2) The production figures are calculated using a regression based on the period 1970-1975 from data taken from the ECE/Steel/29 document 1980.

(3) The net deficit of CMEA countries in respect of the rest of the world is obtained by subtracting (2) from (1).

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(49) See the report on the OECD Conference: Symposium on the Steel Industry in the 1980s, Paris 27/28 February 1980.

(*) One of the essential factors would be the self-sufficiency of the United States.

Obviously, consumption estimates may be modified downward, and by then, investment programmes may augment production capacities. The deficit anticipated relates to Eastern European countries other than the USSR.

However, taken overall, it does not appear that the CMEA block will be a net exporter.

112. To the extent that current restructuring of Western iron and steel industries is orientated towards the "top of the range", a "target" could be arranged to ensure the more or less continuous importation of simpler products from developing countries capable of exporting. A system of partial compensation agreements based on the exchange of steel products could be developed in order to provide developing countries with the "life-line" they require for their steel balance of payments.

With respect to hypotheses of growth in the volume of international trade implied in the preceding scenarios (apart from the crisis scenario), possible exports from developing countries would continue to constitute a small part.

113. The data and estimates from the various scenarios were then listed and the resulting situations for considered regions of developing countries were reviewed.

82.05.28

2.8 2.5

2.2

2.0

1.8

1.0

1.1

1.25 1.4 1.6

114. <u>The countries of Africa, south of the Sahara</u>

The capacities for iron and steel production are at the present time very limited. Outside Zimbabwe, where RISCO has a production capacity of 1.0 million tonnes of long products, only small units exist in Ghana, Togo, the Ivory Coast, Angola, Kenya, Tanzania, Ethiopia and Uganda; their total capacity is about 0.2 million tonnes of long products.

In 1979 imports into Africa South of the Sahara (excluding South Africa) accounted for 2.2 million tonnes, the apparent consumption of steel being therefore about 2.5 million tonnes.

It will be seen that 24 countries out of 39 do not have any iron and steel projects; in 1990 these countries will have about 160 million inhabitants, and there will be:

- 4 countries with more than 10 million inhabitants,
- 13 countries with more than 5 million inhabitants.

The projects so far launched, studied or under consideration involve about 8.5 million tonnes of new capacity.

As a function of the parameters retained for each of the three major scenarios it has been estimated that the available capacities in 1990 could be as follows:

In millions tonnes	Crisis scenario T1	Trend scenario T	Normative scenario N	N2
Angola	-	-	-	0.050
Benin				0.045
Cameroun	0.036	0.036	0.036	
Central African Rep.	-	-	-	0.055
Chad	-	-	-	0.059
Rep. of the Congo		0.020	0.020	0.020
Ethiopia	-	-	-	0.410
Gabon	+	0.050	0.050	
Ghana	+	0.015	0.215 (1)	
Guinea	-	-	-	0.065
Rep. of Cape Verde	-	-	-	+
Guinea Bissau	-	-	-	+
Equatorial Guinea	-	-	-	+
Ivory Coast	0.034	0.034	0.070	
Kenya	+	+	0.350	
Liberia	+	+	0.700 (1)	
Malawi	-	-	-	0.075
Madagascar	-	-	-	0.110
Comoros	-	-	-	+
Mali	-	-	-	0.080
Senegal		+	0.040	
Gambia	-	-	-	+
Sierra Leone	-	-	-	0.040
Uganda	-	-	-	0.160
Burundi	-	-	-	+
Rwanda	-	-	-	+
Upper Volta	-	-	-	0.075
Togo	+	+	+	
Zambia	+	+	0.050	
Zaire	+	+	0.120	
Mozambique	-	-	-	0.080
Niger	-	-	-	0.067
Tanzania	+	+	0.390 (1)	
Nigeria	2.750	4.050	6.450 (1)	
Mauritius	-	-	-	+
Seychelles	-	-	-	+
Swaziland	-	-	-	0.030
São Tome	-	-	-	+
Zimbabwe	?	?	?	?
Total	2.820	4.215	8.500	1.321

- no project

+ no project retained

(1) see data

115. A normative scenario N

The normative scenario results:

a) from taking into account the existing projects,

b) from the possibility of establishing an iron and steel installation in all countries with a population exceeding 3 millions and on the basis of a minimum per capita consumption of 10 kg of steel (concrete reinforcing rods).

The variant N2 of the normative scenario has an additional capacity of 1,300 million tonnes, or a total of about 9,800 million tonnes.

The cost for constructing these capacities would be, respectively:

- $ 5,015 billion for T1 (crisis)
- $ 7,800 billion for T (trend)
- $ 15,300 billion for N (normative)
- $ 18,300 billion for N2 (normative)

116. The differences which can be seen above arise not only from the quantities but also from the number of the countries which will enter or not enter into iron and steel production.

In the case of Nigeria, the weight of whose projects is determinant for the whole, the difference arises mainly from delays in realization but also from financial problems whilst the fall in oil production continues.

117. Within the framework of Scenario III, which is normative, the application of the Nigerian project will undoubtedly necessitate financial arrangements with bilateral financing from the World Bank and the African Development Bank.

Furthermore the entry of several small countries could constitute a means for mobilizing resources in iron ore, gas, oil, hydroelectric power and timber which is available (in particular in III B).

However, the main questions are whether Nigeria and Zimbabwe are capable of implementing their projects, and where possibilities exist for Nigeria to accelerate the manufacture of flat products and special steels and for Zimbabwe to produce flat products. The question of the production of pipes to meet the requirements of the region's oil countries may also arise.

118. A sub-regional self-reliance scenario R is a difficult prospect.

Certainly iron ore and hydrocarbons are available in Nigeria, Liberia, Guinea, Mauritania, etc.

On the other hand, the region has no coking coal and little sponge iron in place of scrap for feeding the electric furnaces, and little financing apart from Nigeria.

It is obvious that the region cannot be self-sufficient in equipment, engineering and industrial know-how.

In order to overcome the financial constraints, one can imagine cooperation between the countries of North Africa, i.e. Algeria and Libya, with the Arab or Islamic Development Banks. The corresponding deals could involve an exchange of financing and high grade iron ore or sponge iron. However, North Africa and the Middle East has very limited engineering and capital goods production capability, and the projects imply third party cooperation (INDIA).

119. A "core areas" scenario M also appears to be problematic where the 1990 horizon is concerned. Obviously, Nigeria and Zimbabwe will have initial installations, but they do not appear capable of playing a polarizing role in the region at this time.

There still remains the problem of the smaller countries:

- Guinea-Bissau
- Equatorial Guinea
- Cape Verde
- Gambia
- Comoros
- Mauritius
- Seychelles
- São Tome and Domergue

By contrast several countries, which have considerable potential:

- Zimbabwe,
- Cameroon
- Ivory Coast
- Angola
- Mozambique
- Zaire,

could probably develop more ambitious projects within the next few years.

It will be seen finally that in 1978 the 24 countries without projects were only able to devote about US$ 3.0 billion to their gross fixed capital formation.

Africa South of the Sahara: two "flashes"

a) On the subject of Togo, which has built a mini-iron and steel industry of 20,000 tonnes for a cost of $ 50 million, entirely covered by borrowing (suppliers or banks).

Its debts now amount to 3,800 billion FF; it has been under the surveillance of the IMF since 1977.

Servicing the debt will absorb more than 50% of its exports in 1981.

This catastrophic situation has been created by the purchase:

- of a petroleum refinery,
- of a luxury hotel,
- and of the iron and steel works which is functioning badly.
  (see Financial Times of 12.8.81).

In this case the problem posed by the construction of a mini-iron and steel unit could be shown to be ruinous.

b) On the subject of Nigeria

Nigeria is devoting more or less half of the investment in the 1981-85 Plan to iron and steel, or about:

$ 2.5 billion.

120. <u>Data on African countries South of the Sahara</u>

<u>Ghana</u>: In the case of T1 no project has been retained.
In the case of T only the small project has been retained.
In the case of N2 the two projects have been retained.

<u>Liberia</u>: The two projects have been retained only in the case of N2, but account must be taken of the fact that out of the 0.7 million tonnes 0.5 million come from an RD project (for export) and 0.2 million from a semi-integrated or integrated iron and steel unit.

<u>Tanzania</u>: Because of the financial situation in Tanzania no realization has been retained either in T1 or in T: by contrast the two projects have been retained for N2.

<u>Nigeria</u>:

$$T1 = \left\{ \begin{array}{l} \text{1st phase Agaokuta 1.3} \\ \text{1st phase Delta Steel 1.3} \\ \text{1 unit 0.1} \\ \text{1 unit 0.05} \end{array} \right\} = 2.75 \text{ mt}$$

T2 = T1 + 2nd phase Agaokuta, 1.3 of the first stage = 4.05 mt

N2 = T2 + Agaokuta stage = 6.45 mt

121. North Africa and the Middle East

The apparent consumption of the zone in 1979 was about 13 million tonnes.

Capacities existing at the same date were 5.7 million tonnes including 1.5 in Egypt, 2.0 in Algeria (1.5 being completed), 0.2 in Tunisia, 0.4 in Qatar, 1.0 in Iran and 0.2 in the Lebanon, Jordan, Syria, etc.

It will be seen that, out of the 24 countries of North Africa and the Middle East (including Djibouti, Somalia, Sudan and Mauretania), 16 do not have any projects: these countries will have 45.0 million inhabitants in 1990.

The projects launched, studied or under consideration cover slightly more than 20,000 tonnes of new capacity (including the second phase of the Libyan Misurata project).

As a function of the parameters retained for each of the three major scenarios it has been estimated that the available capacities for 1990 could be as follows:

In millions tonnes capacity[1]	T1	T	N	N2
Mauritania	-	-	-	-
Morocco	0.450	0.610	1.110	
Algeria	2.050	2.050	2.050	
Tunisia	0.230	0.230	0.230	
Libya	1.250	1.250	3.500	
Egypt	0.850	0.850	1.600	
Sudan	-	-	-	0.220
Djibouti	-	-	-	-
Somalia	-	-	-	0.050
Saudi Arabia	1.000	1.000	1.000	
Bahrain	0.030	0.430	0.430	
Qatar	-	0.400	0.400	
Abu Dhabi	-	-	0.400	
Oman	-	0.125	0.125	
Kuwait	-	-	-	
Dubai	0.035	0.035	0.035	
Israel	-	-	-	
Jordan	0.162	0.162	0.412	
Lebanon	-	-	-	
Syria	0.180	0.180	1.180	
Iraq	1.250	1.250	2.050	
Iran	1.500	1.400	6.900	
Arab Rep. of Yemen	-	-	-	0.070
Democratic Rep. of Yemen	-	-	0.100	-
rounded to	8.900	10.000	20.000	20.500

The normative scenario results from:

a) taking into account the existing projects. This is scenario N;

b) the possibility of providing an iron and steel installation for all countries with a population exceeding 3 million, on the basis of a minimum per capita consumption of 10 kg of steel (concrete reinforcing rod). This is the N2 scenario which has an additional capacity of 0.34 million tonnes, giving an overall total of about 20.5 million tonnes.

(1) See data pages for the breakdown of the projects between the scenarios.

The constructional costs for these capacities would be respectively:

- US$ 15,500 billion for scenario T1 (crisis)
- US$ 16,500 billion for scenario T (trend)
- US$ 31,000 billion for scenario N (normative A)
- US$ 32,000 billion for scenario N2 (variant)

The normative N scenario favours the non-oil producing countries or those with a limited production, such as Morocco, Tunisia, Jordan and Syria, whereas the major oil-producing countries would benefit from improvements made to the direct reduction route.

Scenario N1 has already started in the zone since Egypt and Algeria are producing flat products, with projects for flat products in hand in Libya and Iran, and since diversification of production could be reflected in an acceleration of flat products, of weldless tubes for the oil industry and of high quality products as a function of the energy demand.

122. A scenario R of regional self-reliance has better chances of realization on condition that inter-continental cooperation is achieved between the developing countries.

Financing seems to be assured. Hydrocarbons and natural gas would allow the use of direct reduction. However there are factors which are lacking: there is no (or little) iron ore, in particular of the quality necessitated by direct reduction: there is no coking coal, whilst the problem of water is also a limiting factor.

These difficulties could be overcome by calling on iron ore from Africa south of the Sahara, or on Brazilian or Indian iron ore.

The engineering (the first bases of which exist in Algeria and Egypt), is without doubt the most limiting factor, together with the supply of equipment goods. Collaboration with India and Brazil could give consistency to such a scenario.

In this zone the USSR has participated in the following operations: Iran (Isphahan I. then II), Syria (Havra), Egypt (Helouan II), Algeria (El Hadjar I and II). These interventions have involved the conventional BF/BOF route. It is not very likely that Soviet cooperation will be extended to the direct reduction route during the next decade.

123. Data on the Middle East and North Africa

Morocco	T1: 1st phase of Nador T2: I + small units at Tangiers and Casablanca N2: II + second phase of Nador
Libya	T1 and T: first phase of Misurata T2 + second phase, Misurata
Egypt	T1 and T - realization of Dekkalah N2 + realization of Sadatville
Bahrain	T1 - realization of a mini-plant T and N2 + realization of a DR unit
Qatar	T1: nil T and N2: doubling of Qasco
Abu Dhabi	Realization of project only in III
Oman	Realization of project in II and in III
Jordan	T1 and T: realization of mini-project and tubes T2 + extension of existing mini
Syria	T1 and T: extension of Geco N2 + realization of an integrated unit
Iraq	T1 and T: completion of the first phase N2 + second phase
Iran	T1 and T: extension of Ispahan N2 + Ucabat at Ahwaz (DR) and ex-Baudar Khomeini (DR)

124. Latin America

In 1979 the consumption of the region was 32.35 million tonnes of steel, whereas the installed capacity was about 32-33 million tonnes with an effective production of 28 million tonnes.

It will be seen that, of the 26 countries of Latin America (including a group of "smaller Caribbean countries") 13 have no project for 1990, and at that time they will have about 45 million inhabitants.

The projects launched, studied or under consideration account for new capacities of about 47-48 million tonnes.

As a function of the parameters retained for each of the three major scenarios it has been estimated that the available capacities in 1990 could be as follows:

In millions of tonnes[1]	I	II	III A	III B
Trinidad and Tobago	0.600	0.600	0.600	
Dominican Republic	-	-	-	0.060
Guatemala	-	-	-	0.070
El Salvador	-	-	-	0.055
Honduras	-	-	0.100	
Costa Rica	-	-	-	0.030
Nicaragua	-	-	-	0.040
Panama	-	-	-	0.030
Bahamas	-	-	-	
Jamaica	-	-	-	0.030
Haiti	-	-	-	0.080
Cuba	0.300	0.300	1.600	
Antilles	-	-	-	
Suriname	-	-	-	
Guyana	-	-	-	
Uruguay	-	-	-	0.100
Paraguay	0.100	0.100	0.100	
Bolivia	-	0.100	0.100	
Ecuador	-	0.430	0.430	
Colombia	0.350	0.350	0.850	
Chile	-	-	0.500	
Peru	0.200	0.350	0.550	
Argentina	2.600	3.100	4.800	
Venezuela	4.600	4.000	5.100	
Mexico	10.000	12.500	15.000	
Brazil	13.000	14.000	16.000	
	31.150	35.730	47.730	0.500
rounded to	31.000	36.000	47.500	48.000

The normative scenario results from:

a) taking into account the existing projects: this is scenario N,

b) the possibility of providing an iron and steel installation for all countries with a population of 2.5 - 3.0 million inhabitants, on the basis of a minimal per capita capacity of 10 kg steel (concrete reinforcing rods). This is the scenario N2, which adds an additional capacity of 0.5 million tonnes, giving a total of about 48 million tonnes.

(1) See data page

The constructional costs for these capacities will be as follows:

$55,500 billion for scenario T1 (Crisis)

$60,880 billion for scenario T (Trends)

$75,800 billion for scenario N (Normative A)

$76,800 billion for scenario N2 (Normative B)

The countries most affected by financing difficulties are Argentina, Bolivia, Brazil, Colombia, Chile, Peru and, although it is an oil-producing country, Venezuela. Mexico should overcome by itself the difficulties linked with the rate of realization and the mastery of techniques.

125. The normative scenario N would release the financial constraint which is the most limiting factor in Latin America.

The scenario of diversification N1 is already advanced in the region since flat products are manufactured in Argentina, Chile, Brazil, Colombia, Peru, Venezuela and Mexico, with high-grade and special steels in Argentina, Chile, Brazil and Mexico. An advance in the field of high-grade and special steels therefore appears probable. However substantial progress could also be achieved in the field of the production of equipment goods and industrial assemblies. At the present time this project seems to be halted, amongst other factors by the constraints linked to external financing.

Direct reduction (HYL, HYL III) is a particularly effective instrument for Mexico, Venezuela, Trinidad, Ecuador, Bolivia, Colombia and Argentina; to this should be added the possibilities opened up by the extension of the use (in Brazil) of charcoal.

126. Scenario R, of regional self-reliance, would be largely realizable if the dead hand of financing could be lifted.

Iron ore does not pose any problems either of quantity of quality. Brazil is a major exporter, together with Chile, Peru, and Venezuela which are also exporters. Mexico, Bolivia and Colombia are also producers of ore.

Only Colombia has major reserves of coking coal, still poorly worked; Brazil, Mexico, Peru and Chile also have coal, but generally of mediocre quality. By contrast Mexico, Venezuela, Trinidad, Ecuador, Argentina, Bolivia and Colombia have hydrocarbons and, in particular, natural gas.

Brazil has immense forests, as has also Argentina and Central America, which would make it possible to develop the production of cast iron using charcoal (Honduras project).

In regard to engineering and equipment Brazil is now able to produce 70 to 80% of the equipment which is necessary; by contrast its basic engineering capabilities are far from being sufficient. Mexico is launching a wide-reaching plan to master the design and production of equipment. Capabilities exist in Argentina, and also in Venezuela and Chile. The HYL direct reduction process is of Mexican origin.

Definitively therefore the region seems to be able to provide itself, during the decade, with sufficient capabilities for design work; to develop its experience of direct reduction and to incorporate a major part of the equipment goods necessary for the installation of large-sized units.

The experience of the region is sufficiently well established and diversified, so that educational, technical and management training are sufficient to assimilate the new dimension of the Latin-American iron and steel industry under favourable conditions.

There remains the problem of financing. Only Mexico, Trinidad and Ecuador seem to be able to meet these problems, and it is less certain that Venezuela can do so: it is certainly not the case with the other countries.

127. Scenario M (core areas) present difficulties of realization. Two "core areas" could make claims to be established.

- Brazil, the iron and steel capacity of which will by 1990 exceed the capacity of the British iron and steel industry. Brazil, which is rich in iron ore, is manufacturing an increasing part of its own equipment; it is establishing active relationships with Paraguay (ACEPAR) and Bolivia (MUTUN project). However the capacity for financing in order to play the role of a driving area is lacking.

- Mexico has an ambitious development plan; it has financial resources and energy and it is mastering, in cooperation, one of the dominant processes of direct reduction. However it does not seem likely that by 1990 it will have the engineering and capital goods manufacturing capabilities to allow it to extend its control over the development of Latin-American iron and steel industries.

128. **Latin America**
(data)

Cuba

T1: extension to J. Marti unit 0.3

T: ditto

N2: realization of a stage of the major 2.5 mt project = 1.3 mt

Bolivia

T1: the project is not realized (Mutun)

T and N2: the project is realized

Ecuador

T1: the project is not realized

T and N2: realization of the project

Colombia

T1: first step in the Paz del Rio extension + Ferrohimera project + small unit

T and N2 + second stage of the Paz del Rio extension

Chile

T1 and T

N2: extension of the CAP

Peru

T1: extension at Chimbote 0.2

T + ACEPAR realization

N2: Chimbote extension = 0.4

Argentina

T1: realization of SOMISA extension

T + Sidesur, ZAPLA extension
various semi-integrated units

N2 + first stage SIDINSA

Venezuela

T1 and T: completion of SIDOR - ACELCAR

N2 + first step ZULIA

Mexico

T1 extensions including SICARTSA 4 + TAMPICO 1

T + SICARTSA 5

N2 + TAMPICO 2

Brazil

T1: all extensions except Usiminas III, private units = 1.0 mt

T: private units = 2.0 mt

N2 + Usiminas III

129. Asia

In 1979 the apparent consumption of steel in Asia was of the order of 34 million tonnes.

The existing production capabilities were about 26–27 million tonnes including:

- 13.5 in India, Pakistan and Bangladesh
- 2.6 in the ASEAN countries
- and 11.5 for Far East Asia (excluding China and North Korea).

The projects launched, studied or under consideration relate to new capacities of about 40 million tonnes.

It will be seen that out of 24 countries (or territories), grouping together 100 million inhabitants, eight do not have any project: out of these eight countries four countries have more than 10 million inhabitants.

As a function of the parameters retained for each of the three major scenarios the available capacities in 1990 have been estimated as follows:

In millions of tonnes (1)	T1	T	N	N2
Pakistan	1.100	1.600	2.500	
India	7.500	10.000	12.000	
Bangladesh	0.100	0.600	0.600	
Afghanistan	-	-	-	0.170
Burma	0.020	0.040	0.040	
Singapore	0.250	0.250	0.250	
Malaysia	1.500	1.700	1.700	
Indonesia	1.500	1.500	3.000	
Philippines	0.500	0.500	1.500	
Thailand	1.000	1.500	2.300	
Vietnam	0.250	0.250	0.500	
Kampuchea	-	-	-	
Laos	-	-	-	
Nepal	-	-	-	
Sri Lanka	-	-	-	
Maldives	-	-	-	-
Other Asian countries	2.000	4.500	6.800	
Republic of Korea			8.000	
Democratic Rep. of Korea	( )	( )	( )	( )
(Hong Kong)	( )	( )	( )	( )
Papua New Guinea	-	-	-	
Vanuatu	-	-	-	-
Fiji	-	-	-	-
Democratic Rep. of China	( )	( )	( )	( )
Total	20.720	27.440	39.900	0.550
rounded to	21.000	27.500	40.000	40.500

(1) See data page for the breakdown between the scenarios.

The normative scenario results from:

a) taking into account the existing projects: this is scenario N,

b) the possibility of providing an iron and steel installation in all countries with a population of 2.5-3 million inhabitants, on the basis of a minimum per capita capacity of 10 kg of steel (concrete reinforcing rods): this is the scenario N2 which adds a supplementary capacity of 0.5 million tonnes, giving a total of about 40.5 million tonnes.

The cost of construction of these capacities would be respectively:

$23,000 billion for scenario T1 (Crisis)
$28,000 billion for scenario T (Trends)
$42,000 billion for scenario N
$43,000 billion for scenario N2

130. The normative scenario N implies major changes in the region. In India, for example, where more flexible financing makes it possible to operate simultaneously on the utilization of its own resources and the utilization of alternative foreign sources.

This scenario will also have considerable effects in Pakistan where the iron and steel project under construction (PIPRI) is absorbing 53% of the public industrial investment of the 5th Plan; for Bangladesh again, which does not have any true iron and steel industry despite a population of 75 million inhabitants, and for the Philippines which has not yet been able to undertake, as a result of lack of financing, the construction of its integrated complex. Nor will the effects be negligible in Thailand, Vietnam, Sri Lanka, Burma, Afghanistan and Nepal.

Scenario N would also make it possible to accelerate the rate of development and integration of the iron and steel industries in Malaysia, Indonesia and other Asian countries.

Direct reduction using natural gas would play an effective role in Thailand, Indonesia, Malaysia and Pakistan.

Scenario N1 has begun in the zone inasfar as India, the Philippines, the Republic of Korea and other Asian countries are producing flat products, whilst India, Korea and other Asian countries are producing high-grade steels.

131. A scenario R of regional self-reliance is experiencing considerable difficulties.

The region has simultaneously advantages and limiting factors. India, for example, has high grade iron ore which it exports, whereas other countries (Indonesia and Thailand) only have limited quantities of it.

Thailand, Bangladesh and Pakistan have natural gas, and Malaysia and Indonesia are preparing to export this in large quantities.

In this way Indian iron ore and Malaysian or Indonesian natural gas would make it possible to envisage the partial supplying of mini-iron and steel industries in the region with sponge iron in place of scrap iron.

India is in the process of arriving progressively at self-sufficiency in equipment and engineering. It exports studies and projects (MECON, DASTUR Co.). However the equipment which it manufactures are not sufficient for its own domestic needs. It seems unlikely that India would be able, between now and 1990, to change this situation radically.

The Republic of Korea and other Asian countries are concluding joint-ventures and developing their intervention in the field of technical assistance, the control of sites and the supply of certain equipment.

India has a long and rich experience in iron and steel training which it could provide to the profit of the region.

The experience of the Republic of Korea is more recent but it is satisfactory in regard to the construction of sites and the rate of achieving full production.

By contrast, and where financing is concerned, only Indonesia and Malaysia have, because of their oil resources, certain possibilities, but these do not seem to be likely to be sufficient for a process of regional self-financing in iron and steel. However the banking centre of Singapore - the seat of the Asiatic Development Bank - plays an active role as intermediary in this field.

132. It will be noted that the USSR is engaged in Asia in the construction of projects in Pakistan (PIPRI - first stage), in India (extension of BOKARO and VIZAKAPATNAM project). Undoubtedly this collaboration will continue within the framework of a self-reliance scenario. If the CAEM zone is likely to experience a slight deficit in its supplies the enlargement of compensation agreements cannot be excluded in this case.

133. The region has complex links with the outside, and it is not very probable that these will be greatly extended. These are links with the oil companies of the Middle East, with the Muslim countries, with Australia as supplier of coking coal and iron ore, but particularly with Japan as supplier of equipment, engineering and technical assistance and as the organizer of commercial networks.

134. Scenario M (core areas) has begun to be implemented in Asia where several "cores" and "poles" are sharing in the structuring of the southern and eastern regions of Asia:

- India - this continent is bordered by Nepal, Bhutan, Pakistan, Bangladesh and Burma, but it cannot satisfy their enormous financing needs. India is at the present time giving priority to its relationships with the Arab oil-producing countries in the Middle East and Africa (Nigeria) by offering its iron ore, its engineering capabilities and its equipment against oil and financing, together with the USSR. By contrast India is relatively less closely linked with Japan.

- Japan constitutes the principal "core area". It exercises its influence both on eastern Asia (the Republic of Korea and other Asian countries) and on the ASEAN countries. It sells engineering, equipment, technical assistance, training and iron and steel products and, also, imports natural gas, iron ore and iron and steel products.

  Japan also has a highly selective financing capability which allows it to grant (or refuse) the green light to many projects (for example the Philippino project of MINDANAO to which it would seem that the Japanese have said no) as a function of the orientation which it hopes to give to the world iron and steel network which it is modelling.

  The zone with the Japanese core can only operate by calling on the resources of Australia: this is for iron ore and coking coal. It is also known that Australia is closely interested in the activities of ASEAN; all these relationships constitute a closely interlocking network of interests.

135. In this work it has been unfortunately impossible to obtain sufficiently reliable information on the Popular Republic of China and on the Democratic Republic of Korea(1).

We shall therefore limit ourselves here to reproducing some items of information on this subject.

In the Popular and Democratic Republic of Korea the production capacity for steel, which was 3.2 million tonnes in 1976, should increase to 6.4 - 7 million tonnes in 1984, 5.6 to 6 million tonnes of this being finished products.

In China the production of crude steel will have reached 32.8 million tonnes in 1979 and 37 million tonnes in 1980 (apparently taking into account considerable stocks of semi-products).

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(1) This is a gap which should be filled in because of the importance of the Popular Republic of China.

For 1985 the forecast is for 45 million tonnes of capacity, but it seems that most of the projects have been halted.

For 1990 it would seem to be prudent to count on a capacity of 60 million tonnes or, for China and the Popular and Democratic Republic of Korea taken together, slightly less than 70 million tonnes.

The difficulties in China seem to be not only of a financial order but also organizational.

136. Taking into account China and the Popular and Democratic Republic of Korea the production capacity for <u>all the developing countries</u> would, in 1990, be about 200 million tonnes on the lowest scenario and about 250 million tonnes on the normative scenario.

Despite the substantial changes expressed by way of these scenarios one is therefore very far from the projections which fix the production of the developing countries in the year 2000[50] at 378 million tonnes (lower hypothesis) or 481 million tonnes (upper hypothesis). This, on the basis of an operating level of 85%, would imply production capacities of the order of 450 to 560 million tonnes. Under these conditions it would be necessary to double the 1990 capacities during the nineties. This is another story which will largely depend on the course which iron and steel development follows during the period 1980-1990.

(50) Draft World-wide study on the Iron and Steel Industry 1975-2000 - Unido/ICIS.25 - 15 December 1976, prepared for the First World Consultation.

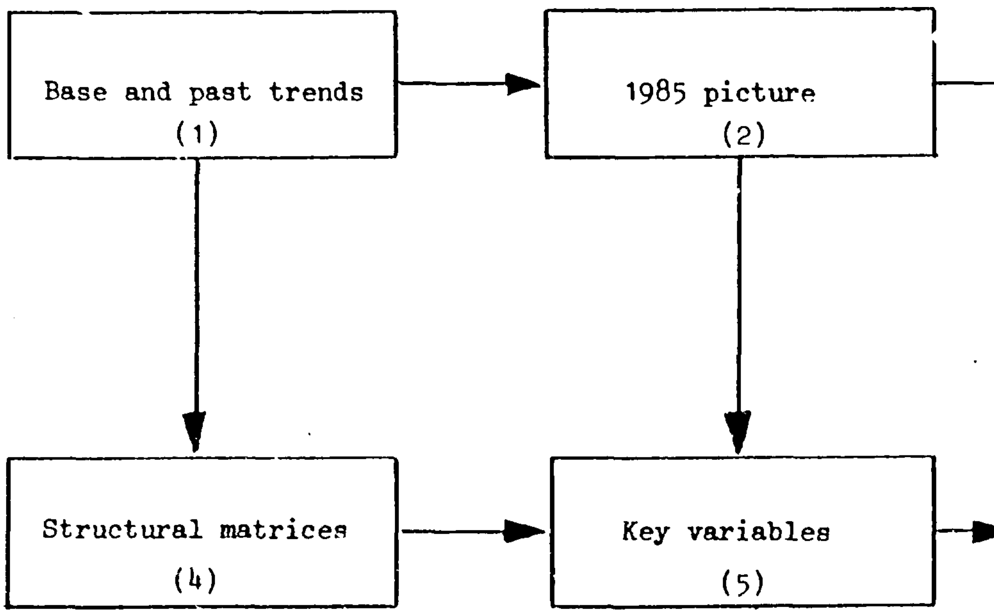
137.

Asia
(data)

Pakistan	T1: first stage of Pipri T + DR project N2 + second stage Pipri
Bangladesh	T: Chittagong extension T1 and N2 + DR project
India	T1: extension + first stage VIZAKAPATNAM + others T + Paradep + Vijayanagar N2 + second stage VIZAKAPATNAM
Burma	T1: DR unit T and N2 doubling of the unit
Singapore	T1, T, N2 0.25 extension
Malaysia	T1: 2DR + 1 extension T and N2 + second extension
Indonesia	T1 and T: Phase III of Krakatau + ISPAT N2 + phase IV of Krakatau
Philippines	T1: Various small projects T: Various small projects N2 + Mindanao project
Thailand	T1: small projects + part of first stage project T + part second stage N2: whole of major project
Vietnam	T1 and T: reconstruction of the 0.25 unit N2: doubling of this unit
Other Asian countries	T1 and T: various phases of CSC extension N2
Republic of Korea	T1 and T: latest Risco extension + extension of medium-size units + 1st stage of new project N2 + second stage new project

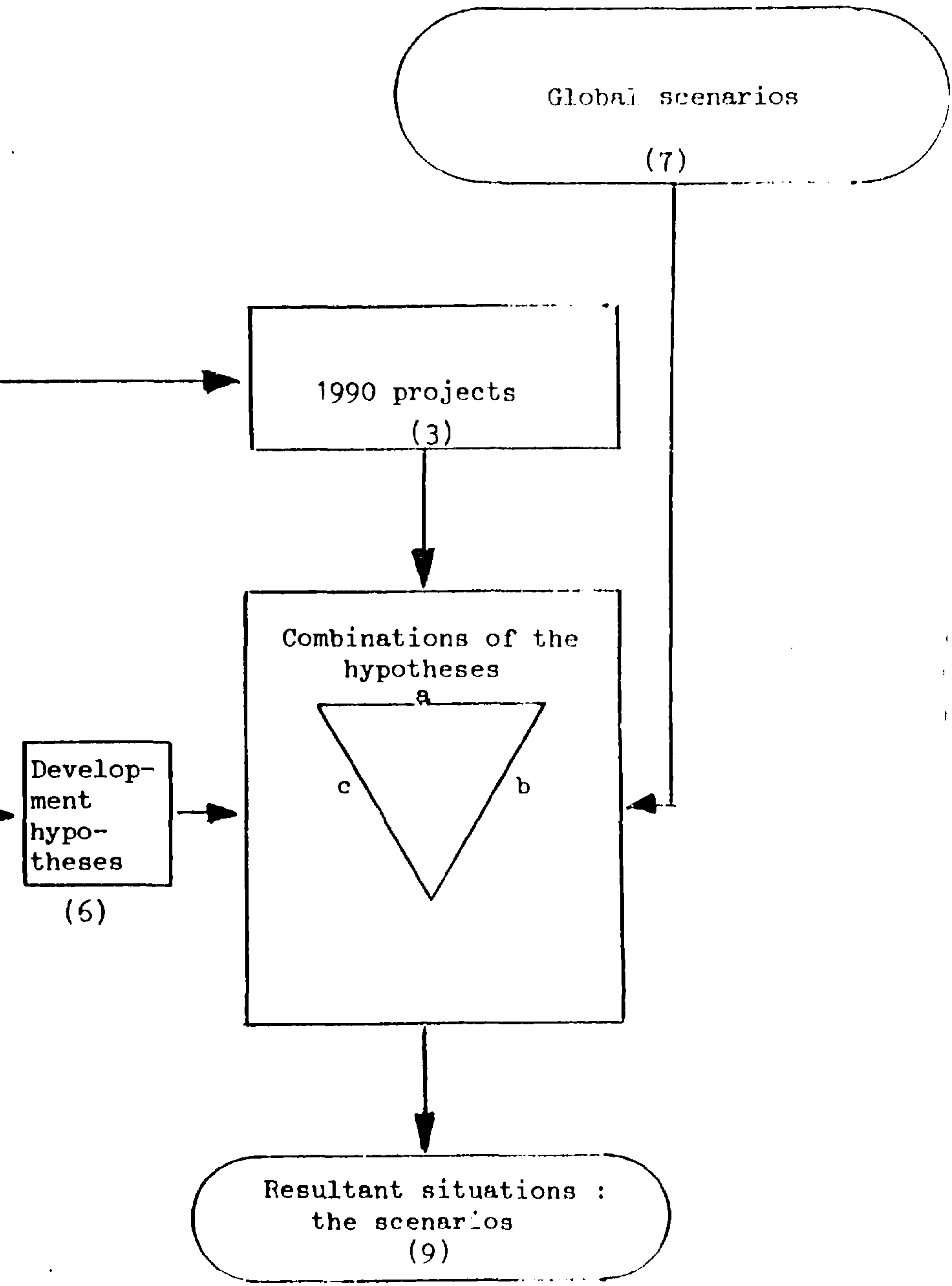
Diagram No. 1

METHODOLOGY USED FOR PREPARING THE 1990 SCENARIOS



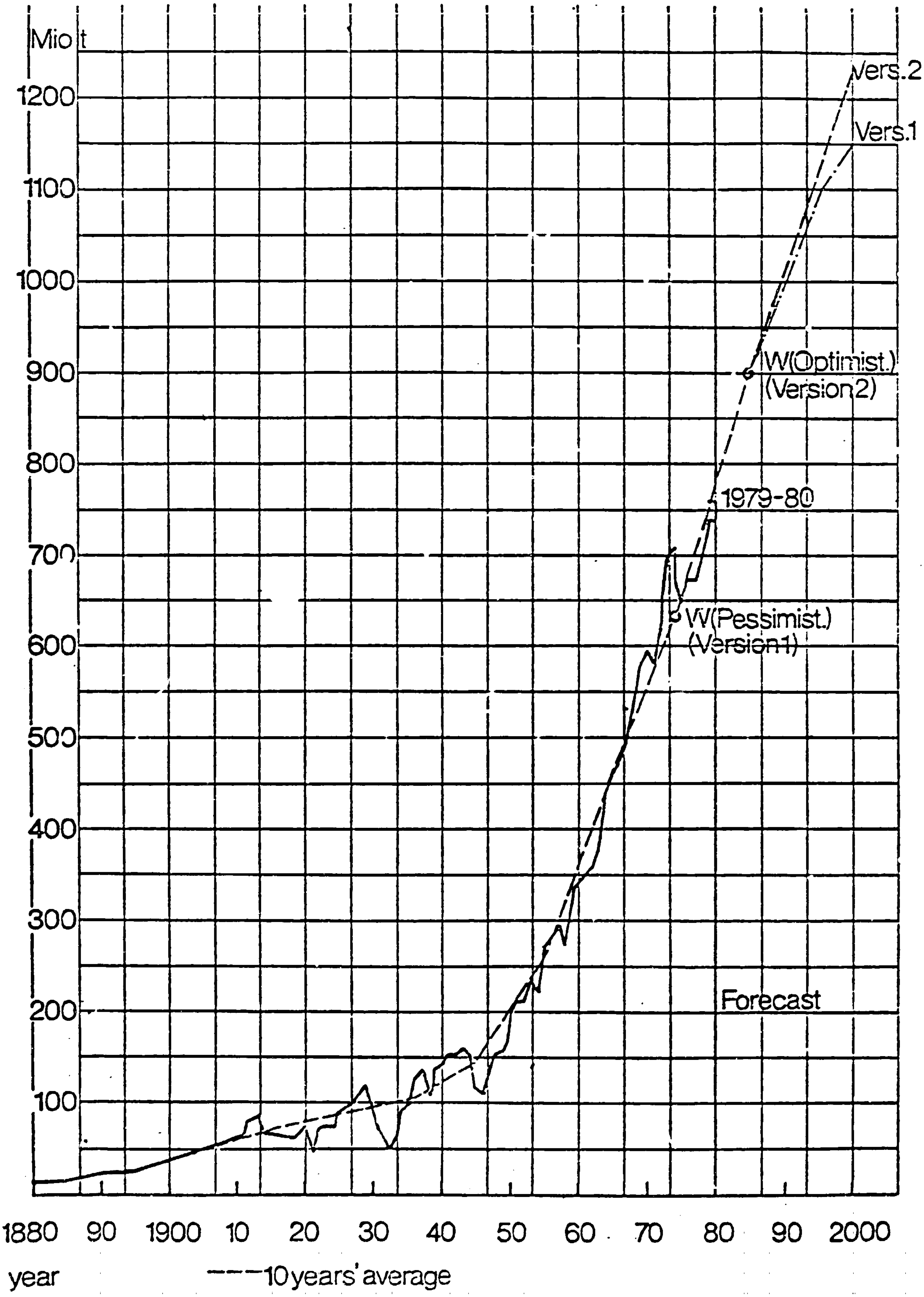
a = macro-economic hypotheses = 3
b = socio-political hypotheses = 4
c = sectoral hypotheses = 6

13



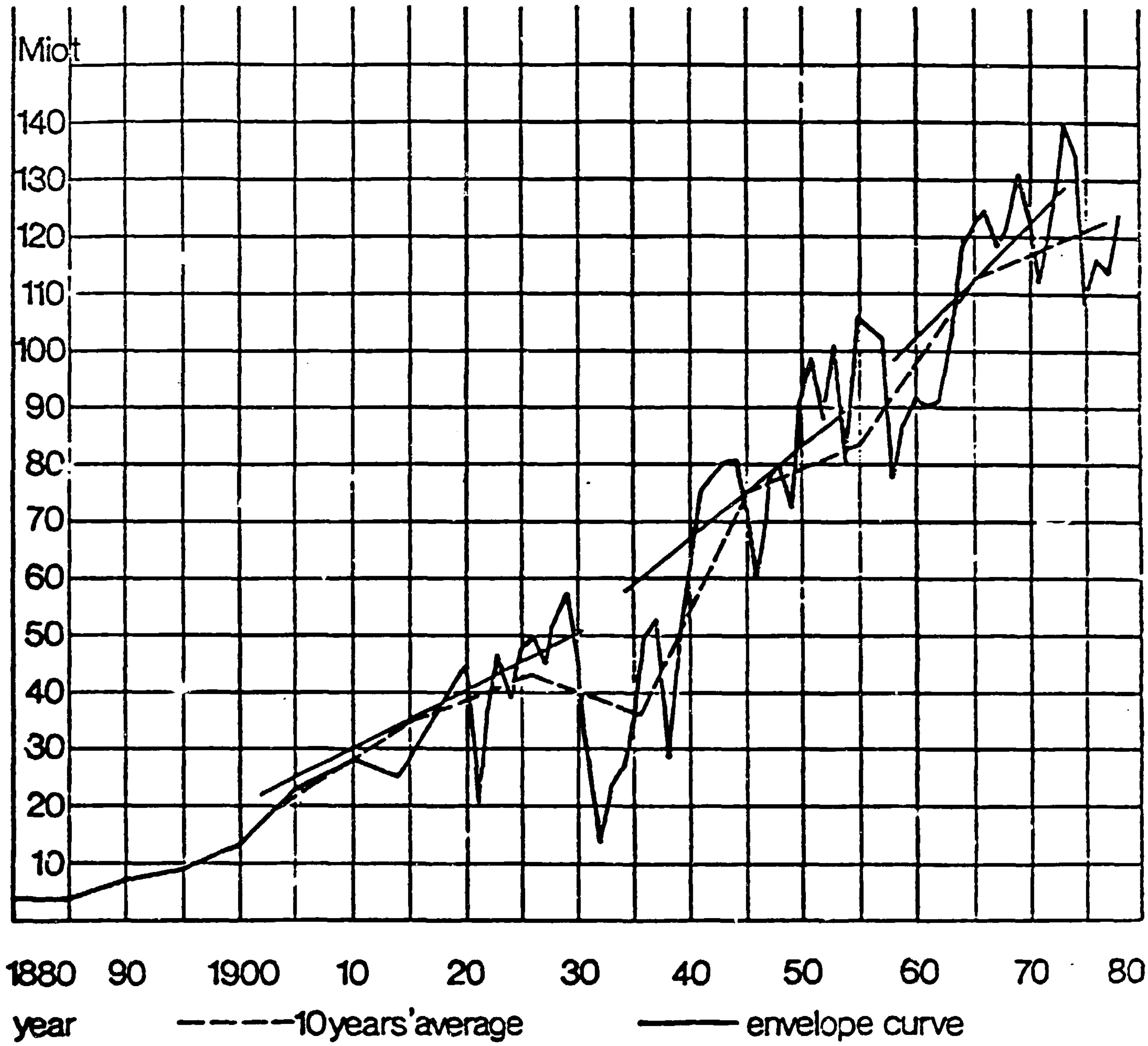
PFG/KFWD
15/12/1981

WORLD Steel production

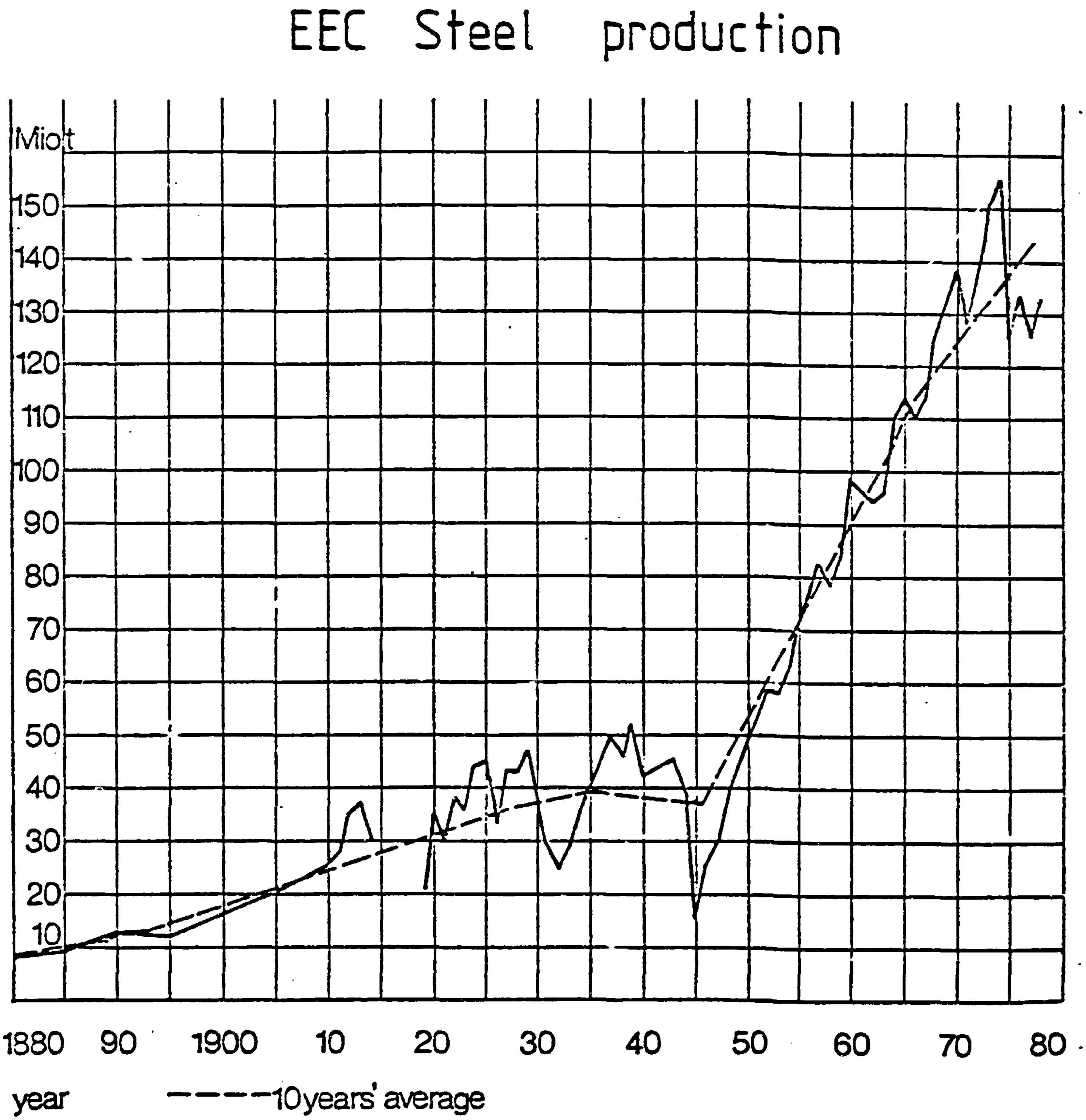


Graph No. 3

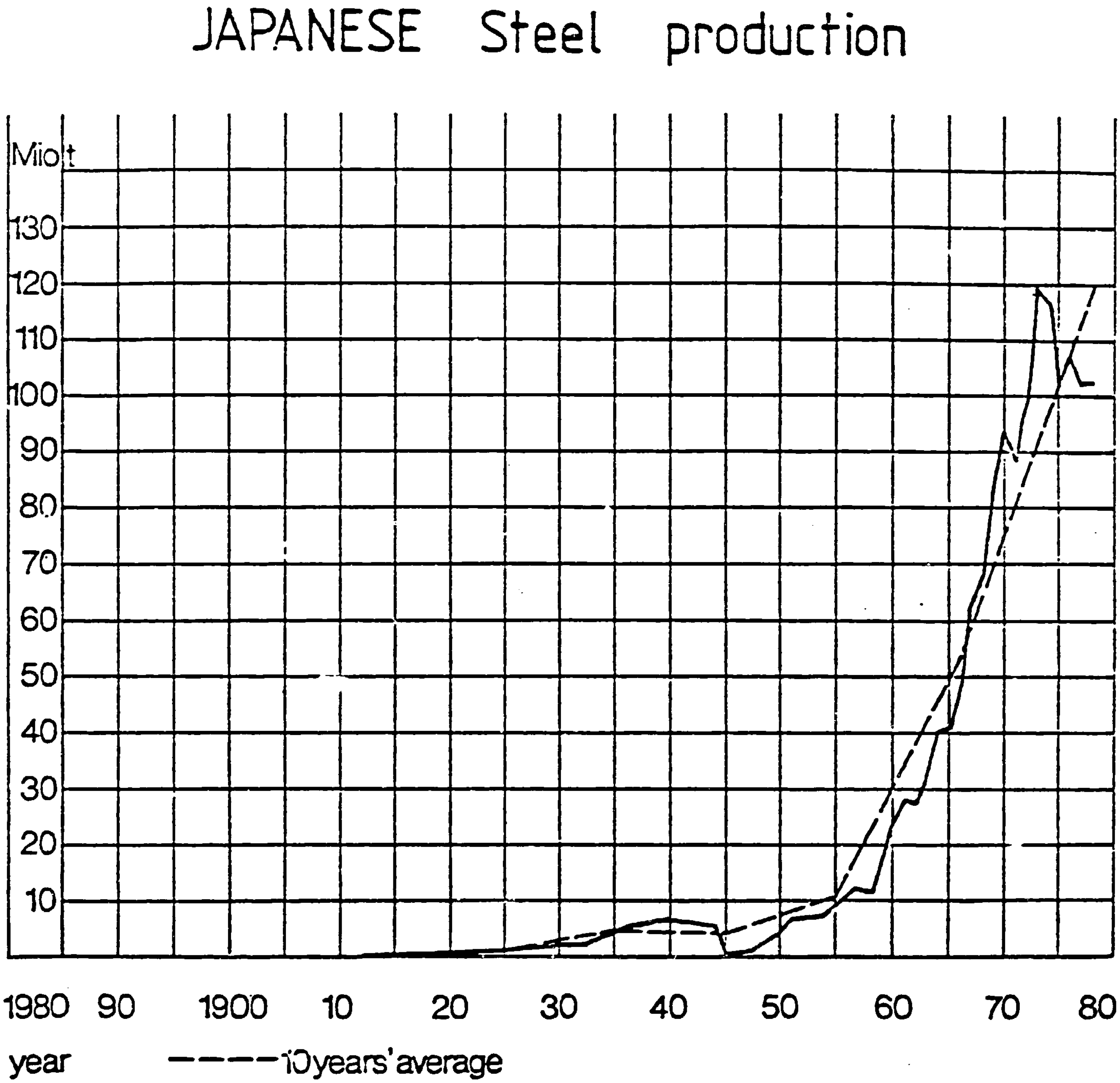
USA Steel production



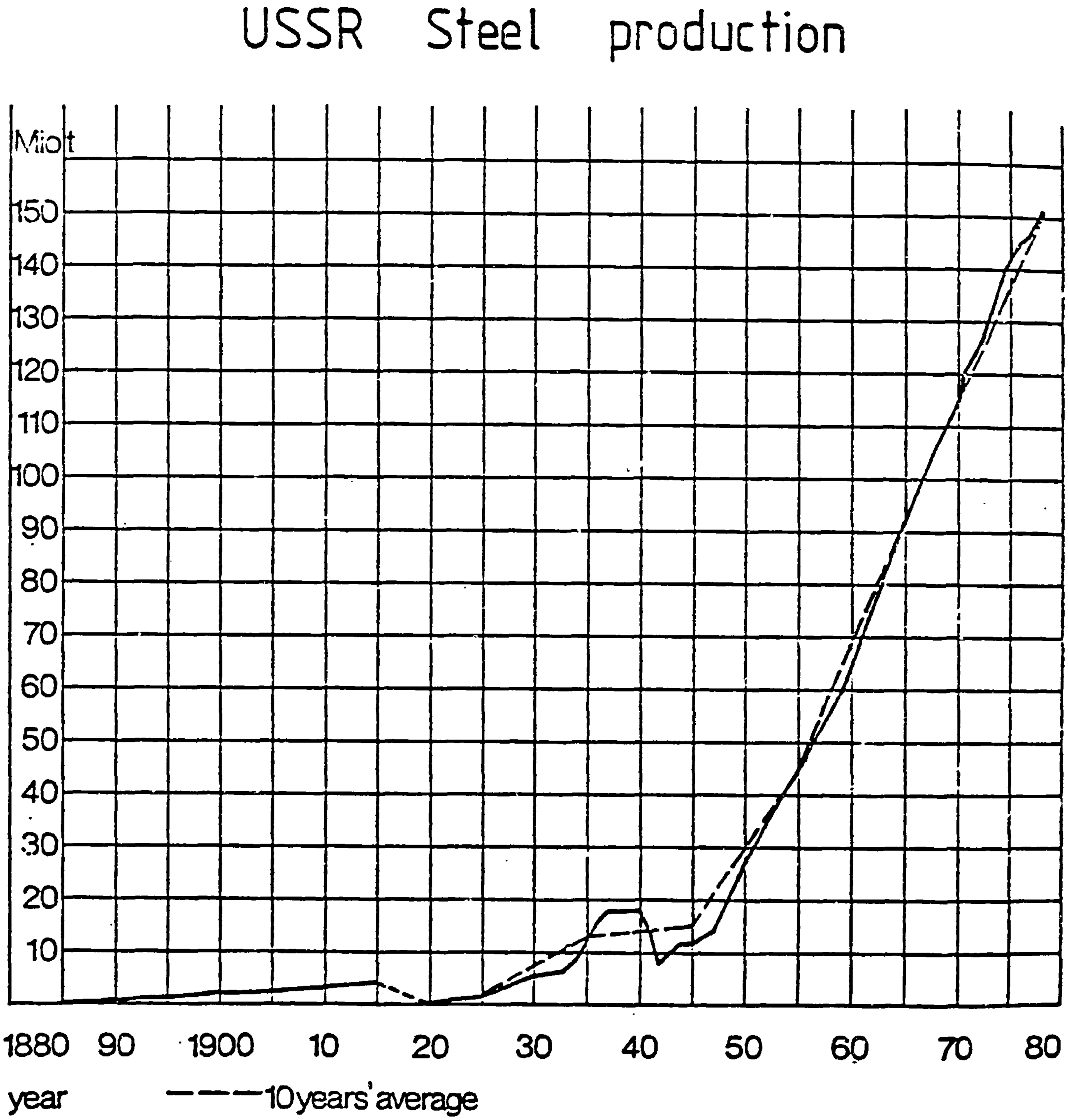
Graph No. 4


EEC Steel production
Mio t
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
1880
90
1900
10
20
30
40
50
60
70
80
year
----10 years' average

Graph No. 5

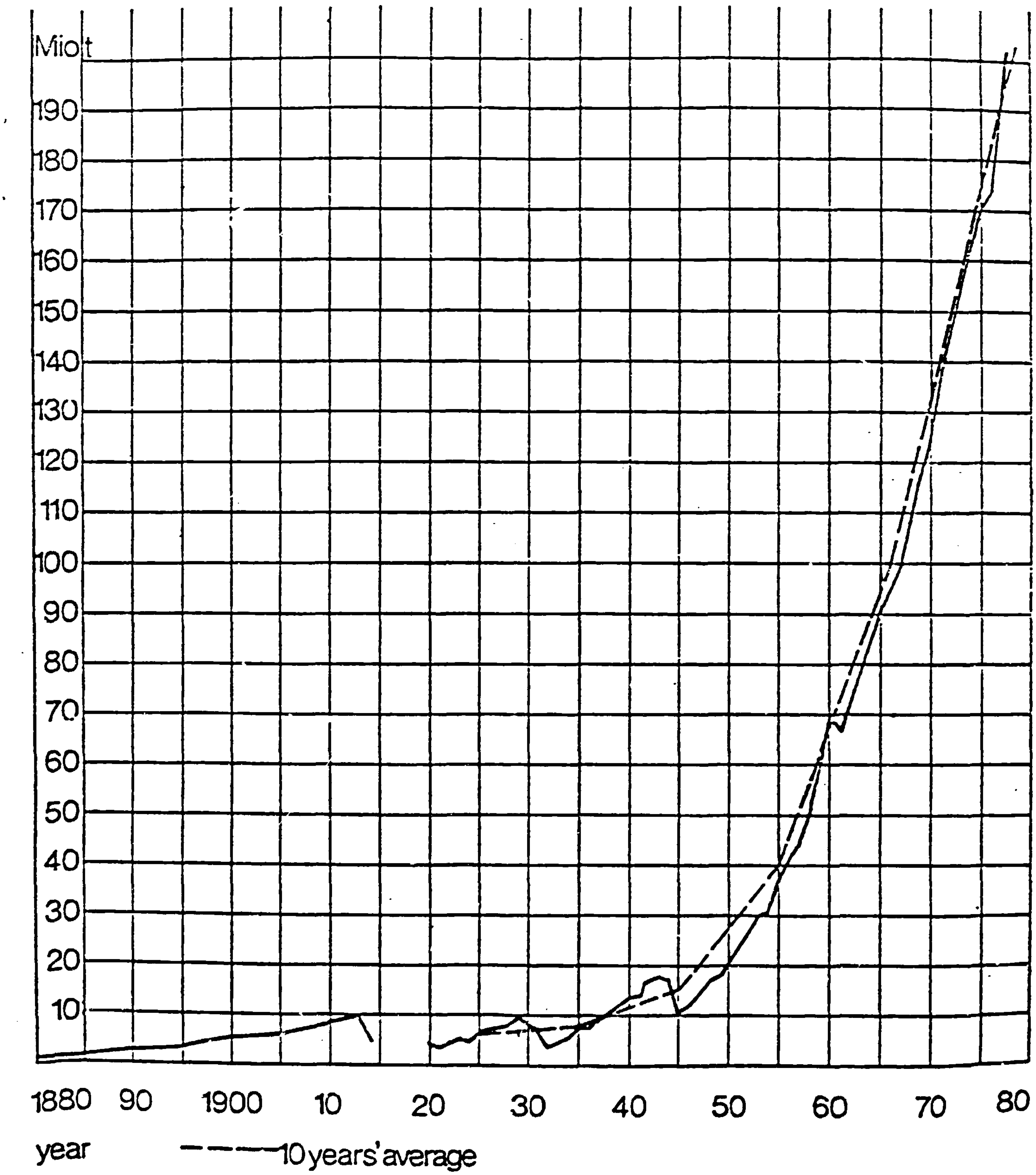

JAPANESE Steel production
Mio t
130
120
110
100
90
80
70
60
50
40
30
20
10
1980 90 1900 10 20 30 40 50 60 70 80
year
----- 10 years' average

Graph No. 6


USSR Steel production
Mio t
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
1880
90
1900
10
20
30
40
50
60
70
80
year
10 years' average

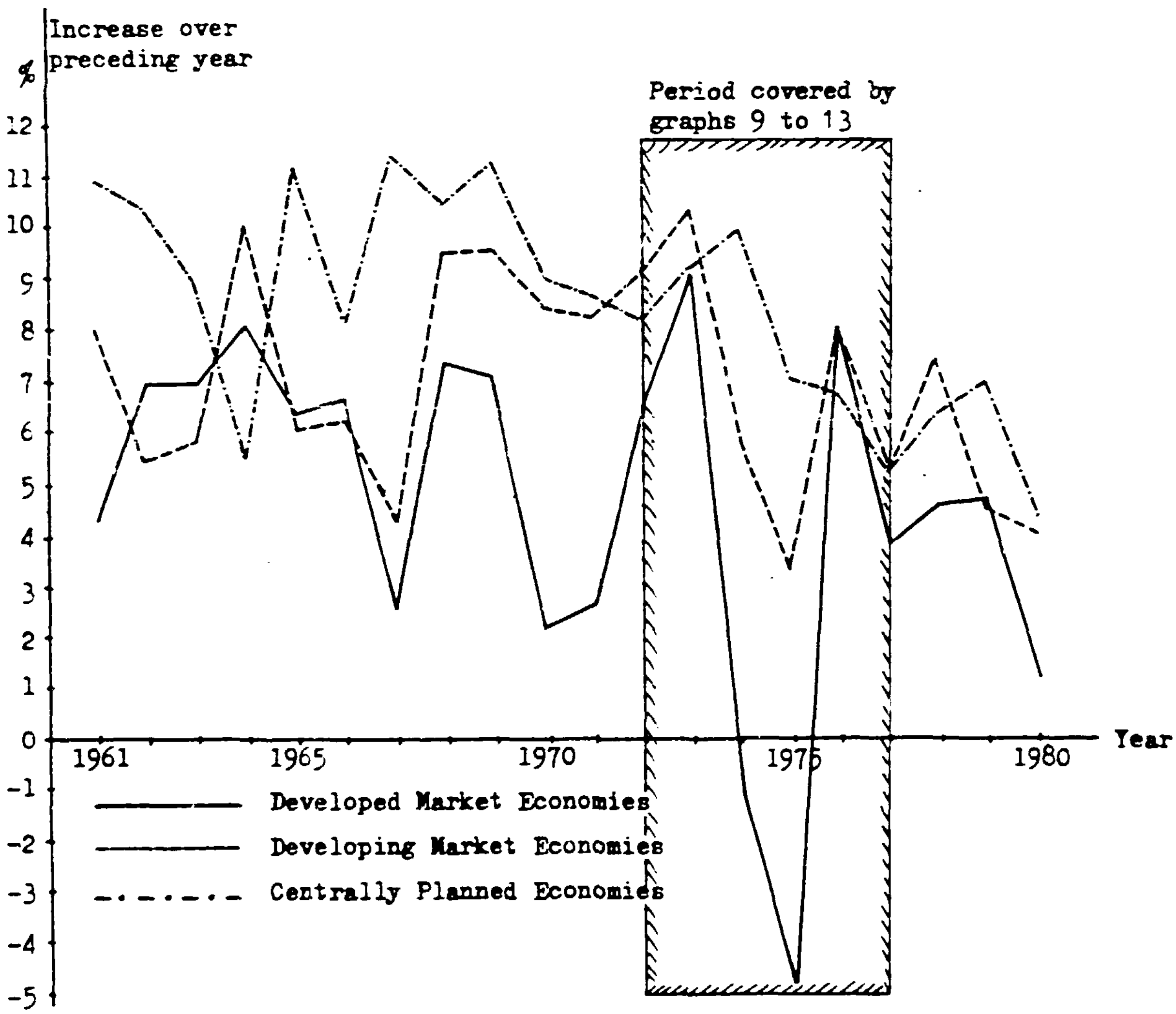
Graph No. 7

OTHER COUNTRIES: Steel production



Graph No. 8

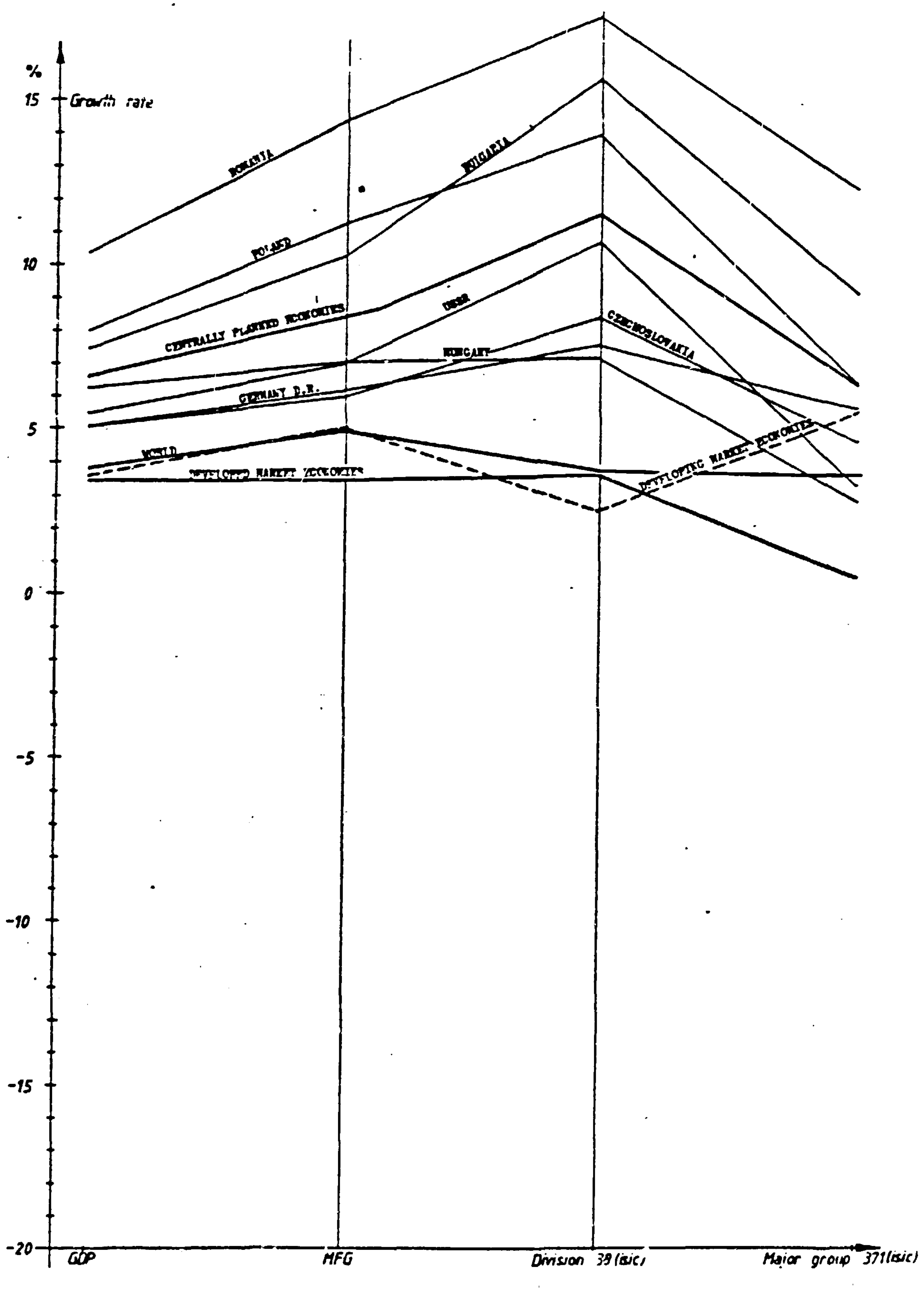
ANNUAL INCREASE IN MANUFACTURING VALUE ADDED
BY ECONOMIC GROUPING, 1960-1980



Source: UNIDO data base, information supplied by the United Nations Office of Development Research and Policy Analysis, the United Nations Statistical Office, United Nations, Monthly Bulletin of Statistics, November 1980 and estimates by the UNIDO Secretariat.
[Extracted from the Industrial Development Survey (to be published)- Regional and Countries Studies Branch, UNIDO].

Graph No. 9

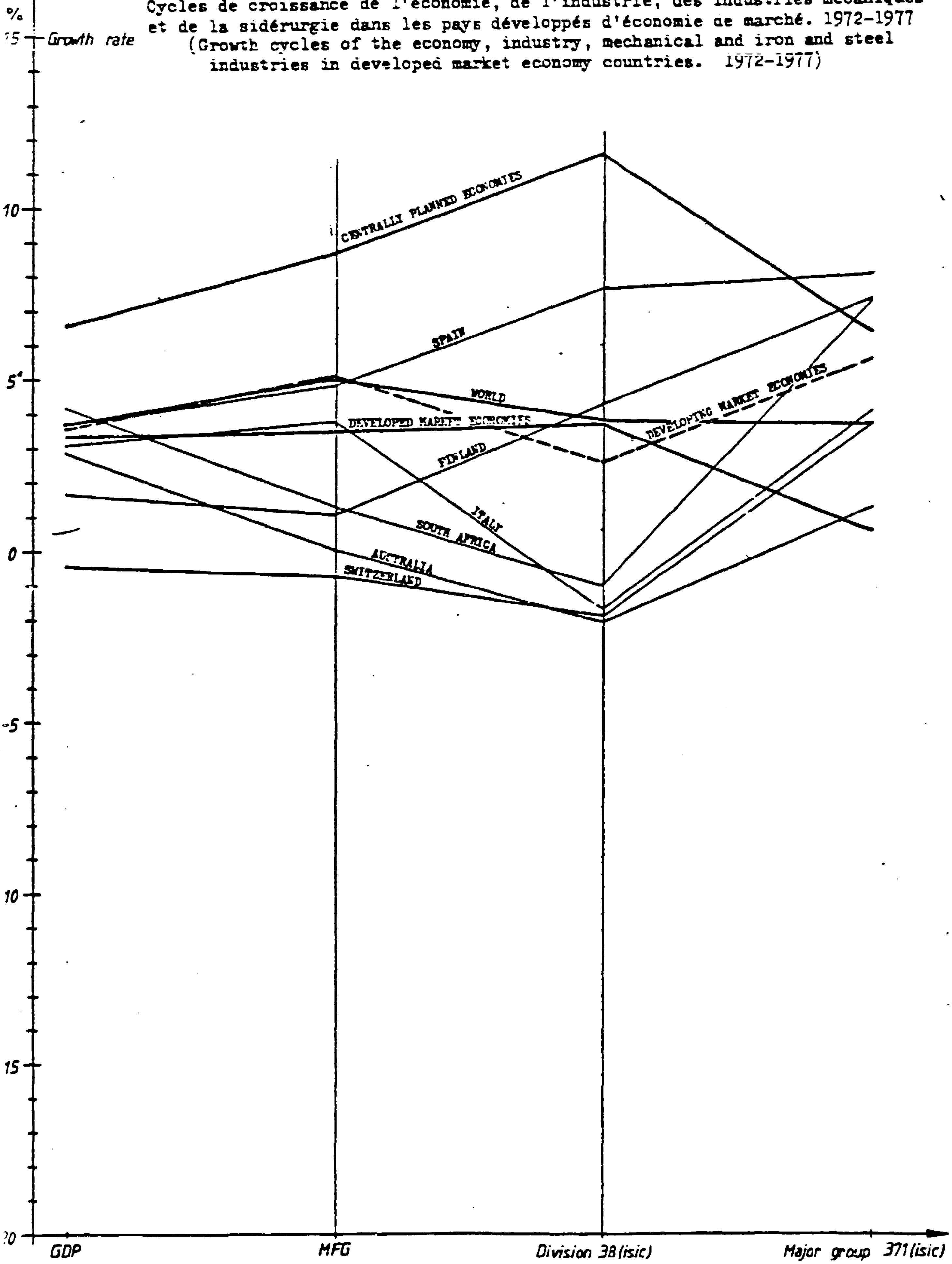
Cycles de croissance de l'économie, de l'industrie, des industries mécaniques et de la sidérurgie dans les pays à économie planifieé. 1972-1977
(Growth cycles of the economy, industry, mechanical and iron and steel industries in centrally planned economy countries. 1972-1977)



CR/RN
16.2.81

Graph No. 10

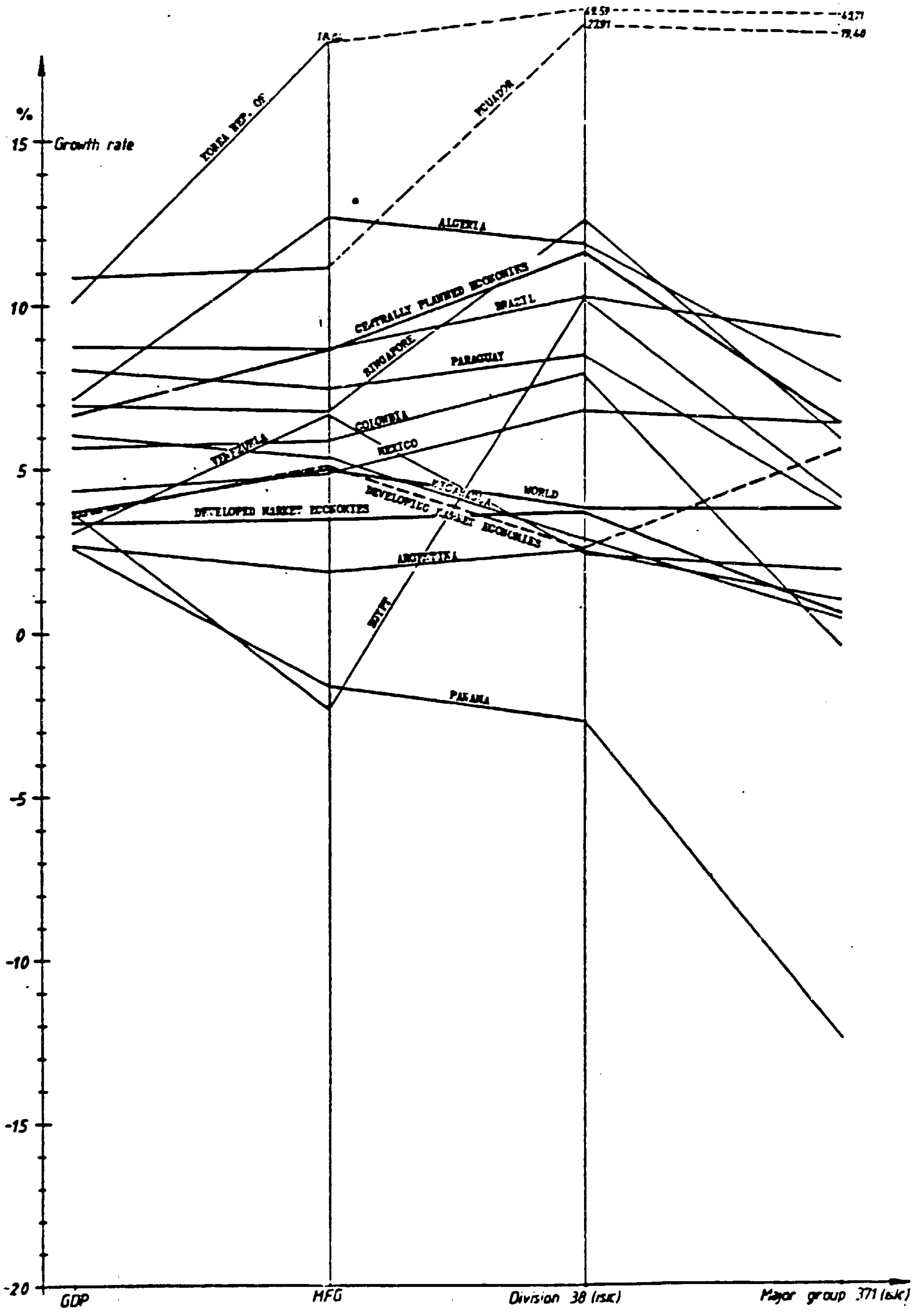
Cycles de croissance de l'économie, de l'industrie, des industries mécaniques et de la sidérurgie dans les pays développés d'économie de marché. 1972-1977
(Growth cycles of the economy, industry, mechanical and iron and steel industries in developed market economy countries. 1972-1977)



CR/RN
17.2.81

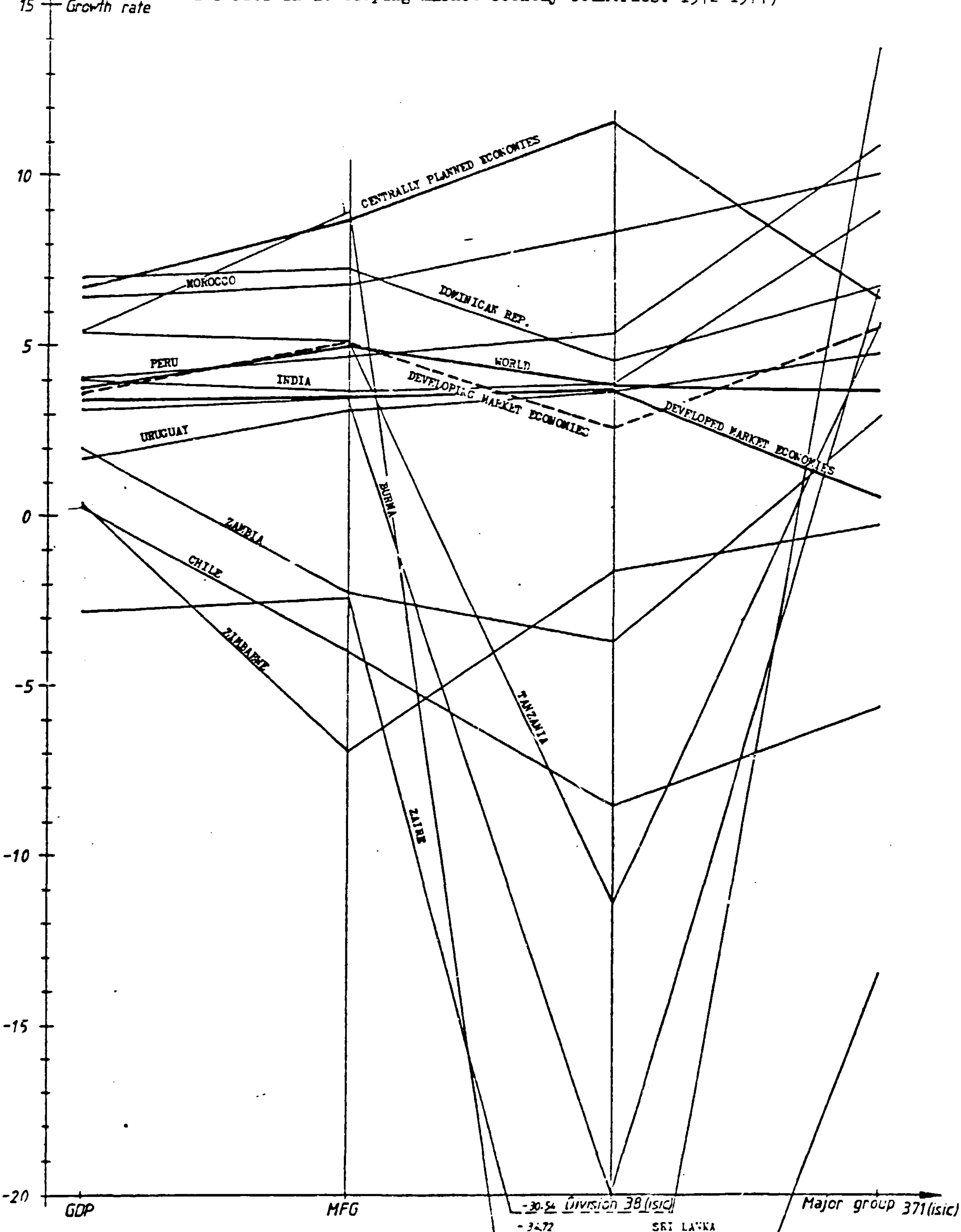
Graph No. 11

Cycles de croissance de l'économie, de l'industrie, des industrier mécaniques et de la sidérurgie dans les pays en développement a économie de marché. 1972-1977
(Growth cycles of the economy, industry, mechanical and iron and steel industries in developing market economy countries. 1972-1977)



C/RN
17.2.81

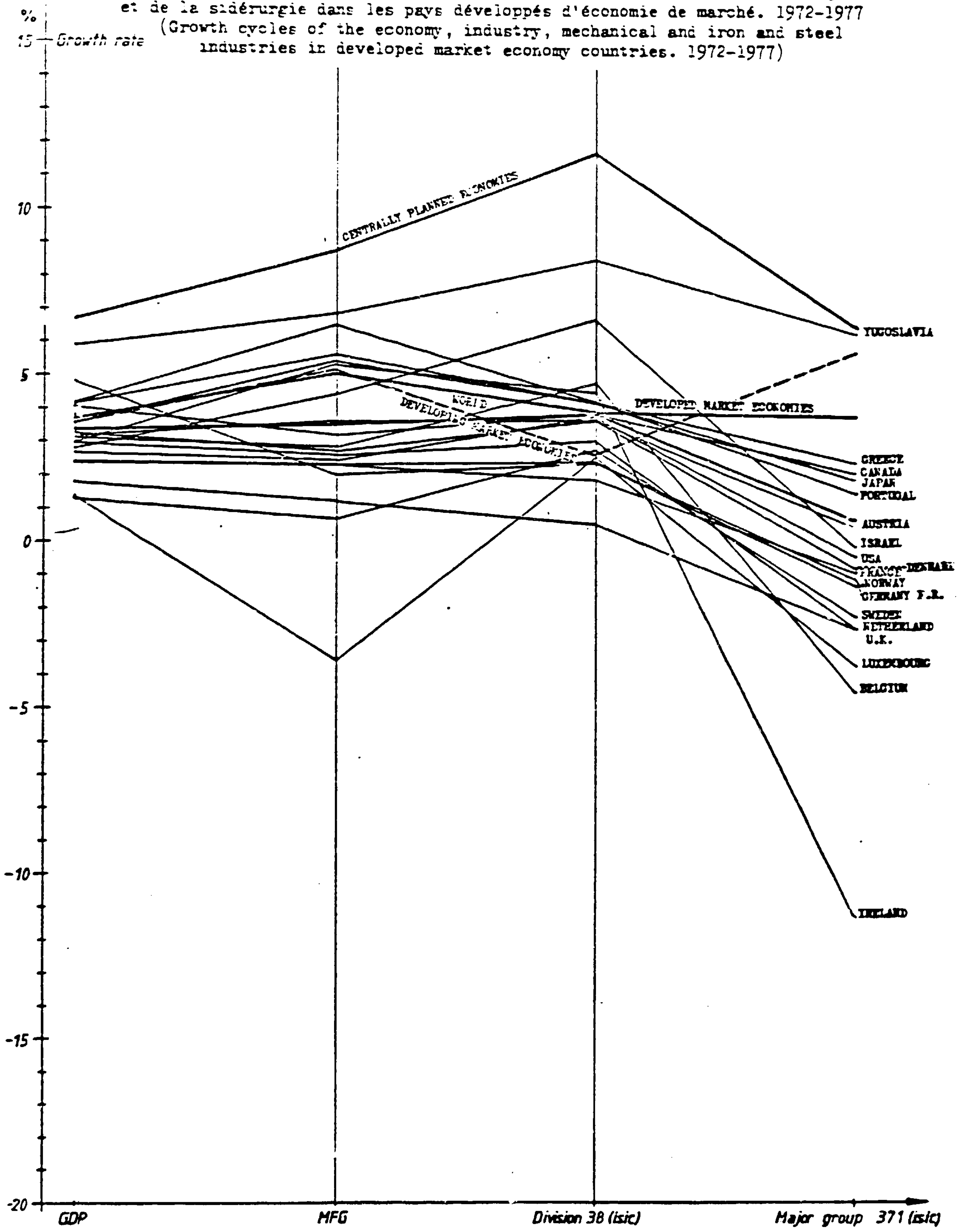
Cycles de croissance de l'économie, de l'industrie, des industries mécaniques et de la sidérurgie dans les pays en développement a économie de marché. 1972-1977
(Growth cycles of the economy, industry, mechanical and iron and steel industries in developing market economy countries. 1972-1977)



CR/RN
16.2.81

Graph No. 13

Cycles de croissance de l'économie, de l'industrie, des industries mécaniques et de la sidérurgie dans les pays développés d'économie de marché. 1972-1977
(Growth cycles of the economy, industry, mechanical and iron and steel industries in developed market economy countries. 1972-1977)



CR/RN
12.2.??