OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

15128-E

ID

Distr.
LIMITED

ID/WG.458/5
22 November 1985
ENGLISH
ORIGINAL: FRENCH

United Nations Industrial Development Organization

Fourth Consultation
on the Iron and Steel Industry

Vienna, Austria, 9-15 June 1986

THE INTEGRATED DEVELOPMENT OF THE IRON AND STEEL INDUSTRY AND THE CAPITAL GOODS SECTORS IN DEVELOPING COUNTRIES*

Prepared by

Pierre Judet**
UNIDO consultant

---

*The views expressed in this paper are those of the author and do not necessarily reflect the views of the UNIDO secretariat. Mention of firm names and commercial products does not imply the endorsement of UNIDO. This document has been translated from an unedited original.

**Director, Institute of Economic Research and Planning of Development (IREP-D), University of Social Science of Grenoble, France.

V.85-28886 (EX)

TABLE OF CONTENTS

INTRODUCTION: A HISTORICAL CONSTANT

The history of the iron and steel industry since the first boom of the Industrial Revolution in Great Britain and Western Europe at the end of the 18th century was closely linked to impulses from successively dominating and innovating activities.

Since the end of the 18th century, agriculture, the iron and steel industry's first customer (tools, iron fittings, etc.), has benefited from the improvements made in the production of cast iron and commercial iron 1/.

We are more familiar with the role played by the English iron and steel industry in supplying the manufacturers of steam engines, textile machinery and machine tools.

During the 19th century, iron and steel production took a real leap forward due to the increasing construction of railway networks and the tremendous demand for rails and rolling stock. Between 1860 and 1880, the BESSEMER, MARTIN and THOMAS processes supplied high-quality products, not only for the railways (rails and locomotives) but for all branches of an increasingly diversified industry (sheet steel for shipbuilding, structural steel: Eiffel Tower). A new forward impetus appeared fifty years later thanks to the growth of the automobile industry, for which it was necessary to supply special steels as well as continuous wide-belt assembly lines, converters and giant blast furnaces, continuous casting, etc.

For the last ten years, the depression has been a period characterized by the need to economize on materials and energy. In these conditions, the iron and steel industry finds itself subject to the new requirements of customers who demand products which can function with the highest efficiency - but also cheaply. The iron and steel industry must adapt itself flexibly to the needs of those of its customers who are processors and producers of capital goods.

1/ See P. BAIROCH, "Révolution industrielle et sous-développement", SEDES, Paris 1963.

In the course of 200 years of history, there has been a close connection between the iron and steel industry and the production of capital goods: a connection which was graphically illustrated by the figure of the "Ironmaster", whose empire was built both on iron and steel and on heavy machinery, as exemplified by KRUPP in Germany, SCHNEIDER (Creuset-Loire) in France and SKODA in Czechoslovakia.

The ironmasters are disappearing in Europe, but the privileged relationship between the iron and steel industry, on the one hand, and the manufacturers of capital goods on the other still subsists in the industrialized countries as well as in the developing countries.

In France, for example, the end uses of steel could be broken down as follows in 1980 2/:

Table 1

End uses of steel in France

	%
Construction, public works and metal manufacture	25.0
Automobiles (including commercial and utilitarian vehicles	21.0
Other means of transport	5.0
Mechanical and electrical manufactures	29.1
Metal working and packagings	9.7
Miscellaneous	10.2
TOTAL	100.0

The trend in French steel consumption, therefore, depends less on general economic growth (GNP) than on the activities and goods (capital goods) connected with investment.

2/ P. JUDET, "L'évolution des débouchés de la sidérurgie française - Perspectives à moyen terme". Report for the Ministry of Industry, IREP-D, Grenoble, March 1982.

In the France of 1980, we find that a household expenditure of 1 million francs accounted for the use of two tons of steel, while 1 million francs of investment accounted for an average use of 21 tons of steel.

The demand for steel varies 3/:

- according to the kind of investment:

  16 tons of steel per million francs invested in housing,

  40 tons of steel per million francs invested in industry,

  81 tons of steel per million francs invested in industrial construction,

- according to the goods produced:

  27 tons of steel per million francs spent for automobiles,
  163 tons of steel per million francs for hollow-ware,
  152 tons of steel per million francs for metal manufacture,
  25 tons of steel per million francs for machine tools.

In several developing countries, we have also found a close relationship between the evolution in the demand for steel and the evolution in the Gross Fixed Capital Formation (investment).

This is the case with Tunisia, where, during a period of 15 years from 1950 to 1965, steel consumption depended more on the share of the national product reserved for the Gross Fixed Capital Formation than on the share allotted to consumption 4/. This is also the case with Colombia, where there

---

3/ JUDET report, op. cit. See Office Technique pour l'utilisation de l'acier, Chambre Syndicale de la Sidérurgie Française.

4/ See P. JUDET, "Production et consummation d'acier en Tunisie: la sidérurgie de Menzel BOURGUIBA", ISEA, Tunis 1967.

has been a close parallel for over 30 years between investment and the demand for steel, while the respective evolutions in the demand for steel and the national product are greatly divergent.

It is therefore not surprising that a new breed of ironmasters is to be found in several developing countries.

- in Brazil, where the VILLARES group is strengthening its position in the iron and steel industry, particularly in special steels (VILLARES and VIBASA corporations), but also in giant steel mills (handling 250-ton bars), as well as in its ability to produce rolling-mill cylinders, bloom and billet rolling mills. The VILLARES group recently exported rolling equipment for an American mini-steel plant 5/:

- in South Korea, where foreign firms assisting in the construction of the new Kwang Yang Bay steel plant are obliged to establish mixed corporations with Korean groups such as HYUNDAI, DAEWOOE, K.H.I., etc., which with the help of the Korean iron and steel industry and their foundries, ironworks and heavy machinery plants will provide approximately 50% of the necessary equipment.

To be sure, these examples do not follow any general rule; however, they are important because they reveal the lasting trend towards a rapprochement and close connection between the iron and steel industry, on the one hand, and the capital goods industry on the other.

5/ Under SMS licence, see Metal Bulletin Monthly, September 1982.

I. THE IRON AND STEEL AND CAPITAL GOODS INDUSTRIES: RECENT EVOLUTIONS IN THE DEVELOPING COUNTRIES

The world iron and steel industry is undergoing a crisis. The period of rapid growth between 1945 and 1974 gave way to a setback and then to stagnation. The optimistic projections of 1972 (IISI), 1976 (European Economic Community and UNIDO) and even those of the end of the decade have yielded to a more realistic and modest outlook. The forecasts submitted by the IISI 6/ at its Chicago Congress in October 1984 indicate that world steel consumption (gross steel equivalent) will amount to the following:

719 million tons in 1985
722 million tons in 1990
745 million tons in 1995.

In comparison with 710 million tons in 1974, therefore, the average annual growth rate between 1974 and 1995 will not exceed 0.25%. We should also note that the expected growth should come exclusively from the iron and steel production of the developing countries, whose dynamism has been well confirmed during the last decade.

The iron and steel consumption of the developing countries did, in fact, increase by 92.5% between 1974 and 1983, rising from 73.5 million tons in 1971 to 105.3 million tons in 1974, and to 150.2 million tons in 1983 7/, which appreciably transformed the structure of the world consumption of crude steel.

6/ IISI - Institut International de l'Acier de Bruxelles, see Le Monde of 9 October 1984.

7/ Including the People's Republic of China and the People's Democratic Republic of Korea. Sources: IISI and CSSF.

Table 2

Evolution in the pattern of world consumption of crude steel

	1971	1974	1983
EEC	18.4	17.6	13.4
NORTH AMERICA	23.9	22.8	16.0
EASTERN EUROPE	27.1	27.0	31.8
JAPAN	10.0	10.8	10.0
OTHER OECD COUNTRIES	8.3	7.9	6.2
DEVELOPING COUNTRIES including	12.3	13.9	22.6
(Latin America)	(3.4)	(4.3)	(3.5)
(Asia)	(7.3)	(7.1)	(14.7)
(Africa)	(0.7)	(0.9)	(1.9)
(Middle East)	(0.9)	(1.6)	(2.5)
TOTAL	100.0	100.0	100.0

The developing countries gained nearly 9 points, these gains coming mainly from Asia (including China and North Korea).

There was a less rapid but distinct increase in iron and steel production in the developing countries. It rose from:

46.4 million tons of crude steel in 1971 to

60.8 million tons of crude steel in 1974 and to

109.6 million tons of crude steel in 1983, which brought about a change in the structure of world production.

Table 3

Evolution in the pattern of world production of crude steel

	1971	1974	1983
EEC	22.0	22.0	16.5
NORTH AMERICA	20.6	20.5	13.2
EASTERN EUROPE	28.0	26.1	31.8
JAPAN	15.1	16.5	14.7
OTHERS IN OECD	6.4	6.3	7.2
DEVELOPING COUNTRIES, including	7.9	8.6	16.6
(Latin America)	(2.4)	(2.5)	(4.4)
(Asia)	(5.3)	(5.8	(11.4)
(Africa and Middle East)	(0.2)	(0.3)	(0.4)
TOTAL	100.0	100.0	100.0

Steel production in the developing countries increased less rapidly between 1974 and 1983 than their apparent consumption. Consequently, the deficit of the developing countries showed the following picture:

in 1971: 73.5 - 46.4 = 27.1 million tons

in 1974: 105.3 - 60.8 = 44.5 million tons

in 1983: 150.2 - 109.6 = 40.6 million tons.

The developing countries continue to be an outlet of prime importance for the iron and steel industries of the advanced countries.

This situation is likely to persist, inasmuch as six countries (Brazil, China, India, Mexico, South Korea, Taiwan and Venezuela) accounted for 75% of

increased steel production in the developing countries between 1974 and 1983. In the medium term, the situation is even likely to become worse because of the large number of new projects which have either been abandoned or frozen. In fact, all of the projects in Africa south of the Sahara have been abandoned or frozen (except Ayaokuta in Nigeria), as well as most of the Latin American projects (except SICARSTA in Mexico; ACOMINAS, COSIGUA and a few extended operations in Brazil). Work is still going on and some new projects are being launched only in North Africa and the Middle East (Morocco, Libya, Egypt, Iran), as well as in the new industrial countries (South Korea, China, India, Indonesia, Malaysia, Singapore, Taiwan, Thailand). However, approximately 30 million tons of new capacities from now to 1990 will not be enough to reduce the deficit from which the developing countries will continue to suffer.

The recent evolution in the production of capital goods in the developing countries has been less dynamic than their production of iron and steel.

In this field, the modest advance made by the developing countries is far from making any dent in the supremacy of the Industrialized countries.

Table 4

Evolution in the structure of world production in the machinery and electrical industries

	1970	1975	1980
Developed, market-economy countries	71.7	63.0	64.0
Developed, planned-economy countries	25.0	32.7	30.5
Developing countries	3.2	4.3	5.5
- including Asia	(0.9)	(1.3)	(2.4)
Latin America	(1.8)	(2.5)	(2.7)
Africa	(0 2)	(0.5)	(0.4)
TOTAL	100.0	100.0	100.0

Source: United Nations Yearbook of Industrial Statistics - ISIC 38 Nomenclature.

Africa's position is marginal; Latin America is still ahead, but is followed closely by a more dynamic Asia which will lose no time in surpassing it.

However, we will observe that the electrical and electronic industries, as well as the production of transport equipment, are moving ahead faster than the machine industries proper.

Table 5

Annual growth rates of capital goods industries

	World total	Developing countries	Latin America	Asia Middle East	Africa
Total production of electrical and machinery industries	6.8	9.6	9.5	9.8	4.0
including					
Electrical and electronic industries	7.3	12.0	10.0	16.2	2.2
Machinery industries	6.0	6.5	7.7	5.0	6.6
Transport equipment	4.1	10.3	10.8	8.2	3.2

Source: Yearbook of Industrial Statistics 1980.

But the electrical and electronic industries, as well as the production of transport equipment, involve many operations of installation and assembly which it is difficult to compare with the production of capital goods.

In this sector, the developing countries are beginning to take an active part in world exports; first of all, they constitute a growing outlet for the industrialized countries.

Table 6

World trade in products of the machinery and electrical industries

	Share in world exports			Share in world imports		
	1970	1975	1980	1970	1975	1980
Developed countries	87.0	85.0	85.0	65.0	58.0	55.0
Planned-economy countries	11.0	12.0	10.0	13.0	11.0	13.0
Developing countries	2.0	3.0	5.0	22.0	31.0	32.0
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

During the last two decades, about 20 developing countries have begun to produce capital goods. However, 15 countries, mostly in Asia and Latin America, are now concentrating 80% of their production on capital goods; these include, among others, the following countries:

Table 7

Main producers of capital goods

	Number of employees 1979/1980	Share of capital goods industries in value added in 1980 %
China	Several millions	25
India	660,000	20
Brazil	640,000	28
Argentina	350,000	20
Republic of Korea	340,000	17
Singapore	108,000	53
Malaysia	73,000	12
Philippines	50,000	10
Mexico	46,000	19
Indonesia	35,000	7
Colombia	34,000	12

Table 7 (continued)

Main producers of capital goods

	Number of employees 1979/1980	Share of capital goods industries in value added in 1980 %
Venezuela	27,000	8
Chile	17,000	16
Thailand	17,000 (1975)	17
Uruguay	16,000	11

Source: Yearbook of Industrial Statistics.

Some countries have shown remarkable dynamism, especially in the non-electrical machinery sector.

Table 8

Annual growth rate in the non-electrical machinery sector

	1963-1969	1969-1975	1975-1978
France	4.41	5.75	1.47
Japan	17.02	3.63	7.84
Brazil	17.03	29.23	2.62
Colombia	6.63	11.74	14.45
Mexico	15.06	7.43	6.04
Republic of Korea	10.27	22.21	30.09
Singapore	2.43	28.85	5.70

Source: United Nations Statistical Office and UNIDO Secretariat.

Brazil, India, China and Argentina supply about 80% of their domestic market; Korea, Mexico, Taiwan about 50%. Several so-called intermediate countries (Algeria, Colombia, Pakistan, Thailand) have begun to produce general capital goods and agricultural machinery. The smaller and less advanced countries whose capacity is still in the very early stages have to depend on imports.

These distinctions account approximately for those which can be made on the basis of iron and steel activity; we shall return to this approach when we take up the problem of typology farther on.

TECHNICAL AND ECONOMIC EVOLUTIONS AFFECTING BOTH THE IRON AND STEEL AND CAPITAL GOODS INDUSTRIES

The present period is characterized by increased pressure exerted by the users - in this case the producers of machinery and capital goods - on the production of intermediate goods for processing - in this case the iron and steel industry.

> "It would seem in fact, that the time of all-purpose steel has gone by and it is urgently necessary to draw the right conclusions from this fact. In addition to the requirements of the automobile manufacturers there are those of many other users who, owing to lack of care, concentration and satisfaction, may at any time shift their orders to other suppliers. The iron and steel industry is in the process of becoming an industry characterized by quality products which are increasingly more specific and precisely adapted to demands which are just now undergoing a great change. Today, there is no longer any great chance for a product to be used in work of a certain complexity, without some organized technical and commercial action, without the product being adapted to the specific requirements of the user" 8/.

The tendency is towards using iron and steel products which are lighter, finer and of more precise quality:

- from ordinary casting to G.S. casting (or aluminium);
- from cast parts to mechanically welded assemblies;
- from long products to flat products: e.g. from beams (girders) to integral, pressed-steel coachwork, from hot-rolled structural sections to cold-rolled sections (with cold sheet steel);

8/ JUDET report to the Minister of Industry, op.cit., p.55

- from long products to tubes or pipe;
- from strip iron to thin, cold-rolled sheet steel;
- from ordinary steels to special steels and, more generally, towards high-quality steels.

QUALITY AN IMPERATIVE: Iron and steel production is tending towards quality, due to the combined effect of competition by other materials and the growing requirements of users who are faced with the problems of economizing on energy and materials.

The requirements of the oilmen are of long standing: they include strict standards with regard to tubes (pipe) and welding; they have been increased as the result of the use of steel products under very high pressures or at very low temperatures, etc.

Since the energy crisis, in addition to the requirements of the oilmen, there have been those of many other users of iron and steel products, such as automobile manufacturers looking for lighter but more resistant sheet steel; the users of tins, faced with competition between aluminium and tin and interested in tin-free steel. These users simultaneously demand the following:

- products of higher performance,
- products of consistent quality,
- products at competitive prices.

In this trend, the tendency is towards a reduction in the specific consumption of steel 9/.

In the Federal Republic of Germany, it was found that between 1970 and 1977 specific steel consumption declined from

- 412 to 370 kg of steel per 1000 kg of electrical machinery,

---

9/ Economic Commission for Europe, STEEL/AC.6/R.15, 25 May 1984

- 873 to 668 kg of steel per 1000 kg of shipbuilding products,
- 612 to 557 kg of steel per 1000 kg of railway rolling stock 10/,
- 883 to 783 kg of steel per 1000 kg of nuts and bolts 11/.

Between 1950 and 1980, the weight of Soviet diesel locomotives was reduced from 30 to 15 kg per HP. During the same period, the average resistance of the steels used in France for concrete reinforcement was multiplied by 4, which in 1980 resulted in savings of 1,600,000 tons of reinforcing steel as opposed to what would have been used in 1956 for the same volume of construction.

Moreover, machinery manufacturers prefer steels of higher performance, such as:

- sheet steel which is resistant to abrasion by mining equipment;
- lighter, alloyed or stainless steels for office machines, etc.

These trends are particularly noticeable in automobile manufacture in the UNITED STATES, where the average weight of an automobile declined from 1800 kg in 1970 to

1397 kg in 1980 and to

925 kg in 1985.

The manufacture of the same number of automobiles using 770,000 tons of steel in 1985 12/ instead of 1,570,000 tons in 1975.

In JAPAN, where the breakdown of materials used by the automobile industry was as follows:

10/ The average life of railway passenger cars has been multiplied by a factor of 2.3 in a period of 20 years.

11/ Economic Commission for Europe, STEEL/AC.6/R.11/Add.1, 6 April 1984.

12/ Economic Commission for Europe, STEEL/AC.6/R.11/Add.1, 6 April 1984.

Table 9

Materials used in Japanese automobiles (in %)

	1973	1977	1980	1983
Total steel including	81.1	80.9	78.0	76.0
- Ordinary steel	63.6	59.9	54.8	48.8
- Quality steel, including	17.5	21.0	23.2	26.4
Highly resistant steel	( )	(0.5)	(1.4)	(4.1)
Steel plate	( )	(4.4)	(7.1)	(7.8)
Alloyed steel	(17.5)	(16.1)	(14.7)	(14.3)
Non-ferrous metals	5.0	4.7	5.6	5.6
Plastic materials	13.4	14.4	16.4	18.4

Source: Japan Metal Bulletin No. 4446, 6 October 1983.

The most remarkable trends are less indicative of the modest advance of the non-ferrous metals and plastic materials than of the decline of ordinary steels in favour of non-alloyed quality steels (highly resistant steels and steel plate) rather than that of alloyed steels.

A qualitative shift is now taking place within the iron and steel industry, where ordinary steels are gradually giving way to steels of superior quality: preferably, low-alloy steels and more frequently steel plate and highly resistant steels, the result of refined processing (refining ladles) which is better controlled (controlled rolling). As a result, the very sharp border-line which used to separate iron and steel production from ordinary production is becoming blurred, due to the widespread movement towards quality.

ARE THE DEVELOPING COUNTRIES OUT OF LINE?

These countries, in fact, do not respond in any uniform way to the movements which affect the iron and steel and machine industries in the

industrialized countries. Unlike the latter, the developing countries are characterized by a rise in their specific consumption of steel.

Table 10

Evolution in specific steel consumption (Kg of steel per US$ of GIP)

	1960	1970	1980
FRANCE	0.084	0.084	0.050
UNITED STATES	0.097	0.101	0.063
USSR	0.435	0.262	0.218
SWEDEN	0.101	0.094	0.053
BRAZIL	0.067	0.074	0.079
REPUBLIC OF KOREA	0.026	0.088	0.190

Source: Economic Commission for Europe, STEEL/AC.6/R.15, 25 May 1984.

This favourable trend is particularly marked in the case of the Republic of Korea. It has been equally obvious for a long time in Japan. It is probably so everywhere where the foundations of a modern industry and economy are being actively laid in areas of high human density (in Asia rather than in Latin America and Africa). The 18 bridges which Japan is building between the various islands of which it is composed will absorb some 3 million tons of steel, while the artificial island constructed in the bay of Tokyo (as the location for an iron and steel plant) requires 1.4 thousand tons of steel (i.e. 250 kg per m^2).

Even if there is an increase in their specific consumption of steel, the developing countries cannot escape the general trend which is driving the whole iron and steel industry and its products towards higher quality. It would be risky if this trend were carried to extremes, without taking account of the fact that all uses of steel (capital goods) are probably not alike in requiring products of the highest quality or of an absolutely constant quality.

The systematic use of American, Japanese or European standards could tend to drive out local iron and steel products which are considered to be of inadequate quality, not so much because of the actual needs of the user as because of ingrained habits in the most sophisticated foreign markets.

The imperative of quality must not become a "superstition" about quality; on the contrary, it must be taken into account in the interests of a better interconnection between iron and steel production, on the one hand, and the processors of this production (capital goods) on the other.

II. PRODUCTION OF CAPITAL GOODS AND INTEGRATION OF LOCAL IRON AND STEEL PRODUCTS IN DEVELOPING COUNTRIES - WHAT IRON AND STEEL PRODUCTS FOR WHAT CAPITAL GOODS?

CAPITAL GOODS: non-electrical or electrical machines, transport equipment and metal structures require hundreds, thousands or tens of thousands of parts calling for different kinds of iron and steel products (bars, sections, tubes, hot-rolled sheet steel, heavy sheet, thin cold-rolled sheet, etc.), as well as many varieties (mild steels, semi-hardened steels, low or high-alloy steels, high-resistance steels, etc.).

What seems to be the simplest capital goods are made from various iron and steel products which are produced by different processes.

According to an outline prepared in India and showing the different categories of iron and steel products used in manufacturing equipment for agriculture and the agro-food industry 13/, it seems that there is no equipment which uses only one category of products.

- Ordinary pails require
  "bars and wire" and "galvanized sheet metal".
- Rice and flour mills use 7 categories of products (there are 13 in all), namely:
  - cast iron parts,
  - bars and wire,
  - light structural sections,
  - plates (or heavy sheet steel),
  - thin cold-treated sheet steel and strap iron,
  - galvanized sheet metal.
- Mechanical or electric pumps use 9 categories of products out of 13, namely:
  - cast-iron parts,

13/ S. Samarapungavan, "Integrated development of the steel industry, particularly mini-steel linked to capital goods and agricultural machinery", UNIDO, April 1984.

- bars and wire,
- light structural sections,
- heavy structural sections,
- thin cold-rolled sheet and strip iron,
- moulded steel parts,
- drop-forged parts,
- extruded wire,
- tubes.

It will be noted that this outline is simplified and does not specify, for any category, the very special types of steel involved (mild steels, semi-hard or hard steels; carbon or alloyed steels, etc.). Actually, therefore, the 9 categories involved in pump production should probably be multiplied by 2 in order to take account of the actual requirements and the multiplicity of special types.

The following table 14/ is more comprehensive; it summarizes French steel consumption by branches and products for 1982, especially for the branches concerned with the metal, engineering and electrical industries (capital goods).

This table shows the following:

- the exclusive connection between "bar iron" and the Public Works construction sector;
- the modest place of commercial rolled iron (other than beams and heavy structural sections) in supplying the following branches: metal working and engineering construction (10 to 12%, but even more with electrical machinery (4%), railway equipment (7%) and automobile manufacture (2.5%).
- the importance of special steels for metal working (19.5% of supplies), engineering construction (9.4%) and automobiles (15.5%);
- the still greater importance of flat products and the growing place of new or renewed products such as galvanized sheet metal (zincro metal) or other coated sheet metals.

14/ Office Technique pour l'Utilisation de l'Acier, Chambre Syndicale de la Sidérurgie Française, Paris.

Table 11

CONSUMPTION BY BRANCH AND PRODUCTS IN 1982
(in 1000 t)

	1ST PROCESSING PERIOD	METAL WORK	ENGINEERING CONSTRUCTION	ELECTRICAL MACHINES	RAILWAY EQUIPMENT	HOUSEHOLD APPLIANCES	AUTOMOBILES	CYCLES	SHIP-BUILDING	BUILDING	METAL CONSTRUCTION	OWN CONSUMPTION	TOTAL
INGOTS													
DEMI-PRODUCTS		183.2	6.3		0.4		8.3					1.6	199.8
PRODUCTS FOR TUBES	565.0												565.0
BEAMS		38.0	187.1	4.6	20.4		23.7		2.6	192.9	372.7	61.4	903.4
OTHER HEAVY SECTIONS										57.0		165.0	222.0
COMMERCIAL ROLLED IRON	146.1	349.2	381.0	11.3	10.2	0.7	64.?	4.4	23.0	152.9	146.0	29.8	1319.0
BARS										939.4			939.4
WIRE	1042.4	118.5	39.7	1.1			6.4			119.5		0.3	1327.9
SHEET STEEL > 3	919.0	226.6	1182.6	32.9	95.1	11.8	115.0		177.7	57.6	133.4	31.8	2983.3
SHEET STEEL < 3	442.1	899.1	422.6	90.9	9.6	169.1	1422.1	93.6	0.4	48.0	18.9	66.9	3683.3
MAGNETIC SHEET STEEL		30.9	4.8	64.1		2.4	1.0					0.1	103.3
GALVANIZED SHEET METAL	200.5	118.7	76.3	14.9	0.9	29.2	34.4			68.4	34.5	0.8	523.9
OTHER COATED SHEET METAL	164.7	58.8	31.3	15.8	1.0	42.2	191.9		0.4	19.2	12.0	0.8	538.1
STRIP-IRON	584.9	104.4	48.6			0.1	153.8	14.1		6.5	1.5	1.1	914.9
TOTAL ORDINARY STEELS	4064.6	2127.5	2380.4	235.5	137.7	255.4	2013.7	119.3	204.0	1656.7	718.9	352.6	14273.3
TIN		589.4											589.4
TOTAL SPECIAL STEELS	662.5	656.6	247.1	13.9	2.7	18.4	372.8	7.1	6.3	4.2	1.2	21.7	2015.2
TOTAL	4727.1	3373.5	2627.5	249.4	140.4	273.8	2386.5	126.4	211.0	1660.9	720.1	381.3	16877.8

Source: OTIA, Market Studies Department.

There is a contradiction between the diversity and complexity of the iron and steel products required for the manufacture of products of the first and second processing stages (engineering and capital goods) and the very limited range of products manufactured by many developing countries.

Out of 91 developing countries, in fact 15/, (excluding the smallest countries), we find that:

- 28 do not produce any iron and steel;
- 27 produce only concrete reinforcing bars (sometimes with a very narrow range of dimensions);
- 36 produce reinforcing bars and commercial rolled iron (generally light sections);
- 19 also produce hot-rolled sheet steel;
- 20 produce thin cold-rolled sheet steel;
- 12 produce special steels (sometimes a few varieties and in small quantities;
- 7 produce stainless steels (long products and flat products);
- 5 produce magnetic sheet steel, generally of unspecified quality;
- 4 produce fast-cutting steels;
- 35 also produce tubes; 10 of them produce seamless tubes 16/.

This contradiction is particularly pronounced in Africa south of the Sahara, where, out of 36 countries (excluding a few small States such as Sao Tomé, Cape Verde, Seychelles, Comores), as shown in Table 12,

- only 10 have steel plants with an annual capacity of approximately 3,500,000 tons, of which Nigeria and Zimbabwe alone account for 3,300,000. The Nigerian plants are either being completed or are in production, with approximately 200,000 tons divided between 8 units, more than half of which are not in operation or else are operating at 10 or 15% of their nominal capacity,

---

15/ The list of the 91 countries appears farther on in the part concerning typology.

16/ Documentation from IREP.D GRENOBLE based on Metal Bulletin, ILAFA, SEAISI QUARTERLY, etc.

- 6 other countries have rolling-mill capacity; in all cases (16 or 10 + 6) these are capacities for producing reinforcing bars and, marginally, (except in Nigeria and Zimbabwe) light structural sections.

In addition, there are 2 tube works, as well as about a dozen galvanizing plants for corrugated iron.

The same contradiction appears when we compare the production of a few scattered plants, limited in quantities and range(reinforcing bars), with the variety and complexity of the imported products: the diversity of iron and steel products and the complexity of engineering products and capital goods.

In fact, Africa imports relatively few long and light products; on the other hand, it imports a wide variety of flat and other products.

Table 12

Steel production capacities in Africa south of the Sahara

	STEEL PLANTS	ROLLING MILLS FOR LONG PRODUCTS	GALVANIZING PLANTS
MAURITANIA	x (micro)	x	
SENEGAL			
GUINEA			
GUINEA-BISSAU			
SIERRA LEONE			
MALI			
UPPER VOLTA (BURKINA)			
NIGER			
LIBERIA			
IVORY COAST		x	x
GHANA	x	x	
TOGO	x (micro)	x	
BENIN			
NIGERIA	x	x	x
CHAD			
CENTRAL AFRICAN REPUBLIC			
CAMEROON		x	
EQUATORIAL GUINEA			
GABON			
CONGO, REPUBLIC OF			
ZAIRE	x	x	

Table 12 (continued)

Steel production capacities in Africa south of the Sahara

	STEEL PLANTS	ROLLING MILLS FOR LONG PRODUCTS	GALVANIZING PLANTS
BURUNDI			
RWANDA			
ANGOLA	x	x	
ZAMBIA		x	
ZIMBABWE	x	x	x
MOZAMBIQUE			x
TANZANIA	x	x	x
KENYA	x	x	x
UGANDA	x	x	
SOMALIA			
ETHIOPIA		x	x
SUDAN			
MALAWI			
MAURITIUS		x	
MADAGASCAR			
Number of units	10	16	6

Table 13

Imports of iron and steel products in Africa and Nigeria (in 1977)

	NIGERIA	OTHER AFRICAN COUNTRIES
Semi-products	1.9	5.0
Reinforcing bars and light sections	23.1	22.3
Heavy sections	5.2	4.7
Heavy and medium sheet steel	4.9	7.0
Thin sheet metal	26.6	26.6 = 43.0
Strip iron	2.4	2.4
Tin	2.1	7.0
Road equipment	2.2	9.4
Tubes	27.7	9.5
Miscellaneous	3.9	6.1
TOTAL	100.0	100.0

Source: CREA, Algiers 1979

It will be observed that imports in southern and East Africa show a similar structure and are broken down (in 1974) as follows:

Table 14

Imports of iron and steel products in southern and East Africa

Bars and sections	21.90
Miscellaneous sheet metal	44.40
Tubes	9.24
Other products	24.46
TOTAL	100.00

Source: ECA/MULPOC/LUSAKA/IV, 26 November 1980.

Incidentally, on the basis of the available data on the same zone (East and southern Africa), we note that the countries of this region import few ordinary agricultural machines but many more complex transport machines and equipment.

Table 15

Structure of imports of engineering products in East Africa and southern Africa

	1970	1974
Machinery in general	37.5	33.40
Agricultural machinery	4.3	4.95
Transport equipment	36.4	53.80
Other capital goods	21.8	13.85
TOTAL	100.0	100.00

Source: ECA/MULPOC/LUSAKA/IV, 26 November 1980.

Even within ASEAN, where progress in industrialization is already perceptible, there is still a great gap between the variety of iron and steel products which are manufactured there and the needs of the engineering and capital goods industry.

In the ASEAN region, which is inhabited by 270 million people, there is no production of special steels, no production of heavy sections, or any production of heavy sheet (except for one small plant in the Philippines); there is only one rolling mill - an old one - (in the Philippines) for hot-rolled sheet, as well as two cold rolling mills (also in the Philippines).

The first modern plants for producing flat products in this region are either under construction or in the project stage. It will be necessary to wait for their completion before closer relations can be established between iron and steel production, however abundant, and capital goods industries, which are still in progress.

Table 16

Iron and steel capacities installed or projected in ASEAN 17/

	INDONESIA (1)	INDONESIA (2)	MALAYSIA (1)	MALAYSIA (2)	PHILIPPINES (1)	PHILIPPINES (2)	SINGAPORE (1)	SINGAPORE (2)	THAILAND (1)	THAILAND (2)	TOTAL (1)	TOTAL (2)
Mills for reinforcing bars	22	1270	n.d.	250	27	1027	1	320				
			[1]	[600]				[150]				
Section mills	11	325			8	n.d			11	934	88	4573
Wire mills	1	120	1	50	5	227	1	50			[3]	[1000]
			[1]	[250]								
Plate mills					1	90					1	90
Coiler mills	[1]	[1000]	[1]		1	420			[1]	1000 à 1500	1	420
					[1]	[1000]					[1]	[1000]
											[3]	
Cold-rolling mills	[1]	[800]	[1]		2	372					2	372
											[1]	[800]
Galvanizing plants	14	295	4	140	9	396			3	190	30	1020
Tinning plants	[1]	[150]	[1]	[150]	1	110			1	60	2	170
											[2]	[300]
Tubes and pipes	13	450	6	76	11	1242	3	92	7	153	40	2013
Wire-drawing plants	18	250	14	96	3	96	4	60	5	n.d	44	502
TOTAL	79(+1)		25(+3)		68(+1)		9		27(+1)		208(+10)	

Source: SEAISI QUARTERLY Singapore

17/ (1) Number of enterprises
(2) Production capacities, in 1000 t.

[ ] under construction

[ ] projected

Now, the example of those developing countries which have a sizable capital goods industry shows that there is a close connection between the diversification and sophistication of capital goods and the consumption of flat iron and steel products. This is illustrated by the evolution in Venezuela and Brazil.

Table 17

Evolution in the consumption of iron and steel products in Venezuela and Brazil, by major categories

1 - VENEZUELA	1969	1980
Flat products	38.0	47.8
Long products	42.9	32.3
Other products	19.1	20.4
TOTAL	100.0	100.0
2 - BRAZIL	1969	1980
Flat products	61.2	66.2
Long products	20.6	19.0
Other products	18.2	14.8
TOTAL	100.0	100.0

Source: Study on the evolution of the specific consumption of Steel, UNIDO 1984

It is true that the construction of capital goods in a developing country not only involves machinery and equipment but also infrastructure (highways, railways, dams, administrative buildings, industrial buildings, etc.) which are the responsibility of the building and public works sector and which to a very large extent require long products. In a preliminary stage, the construction of infrastructures absorbs a higher proportion of resources than machinery and equipment.

In this connection, it will be noted that the Algerian iron and steel industry, which was planned in an initial phase on the basis of the priority development of the petroleum and engineering sectors (tubes and flat products), had to be readjusted very quickly to capacities for producing long products (bars and light sections) 18/ on the basis of the priority needs of the building and public works sector, which were much greater than had been expected at the end of the 1960s (within the framework of the Seven-Year Forecasts for 1967-1973).

Table 18

Evolution of the relative weight of the client sectors of the Algerian iron and steel industry

	1962-64	1968	1971	1974	1975	1976
Petroleum sector	43.0	47.5	35.0	13.2	22.0	24.6
Building - public works	40.0	36.2	49.0	69.0	62.0	57.5
Other sectors (including mechanical engineering)	17.0	16.3	16.0	17.8	16.0	18.0

Source: Algerian iron and steel industry

During that period, the flat products which had been counted on represented only a minor part of the actual demand (around 20%), while waiting for the establishment of a capital goods industry to change the structure of demand after that initial period.

IRON AND STEEL PRODUCTION AND CAPITAL GOODS PRODUCTION: A DIFFICULT RELATIONSHIP, EVEN ON THE BASIS OF THE MANUFACTURE OF ORDINARY MACHINERY (AND TOOLS)

In any case, the relationship between these two activities does not come about automatically. This is one of the lessons learned from the studies

18/ By constructing a very large rolling mill for long products (more than 500,000 tons annually), as well as by doubling the capacity of one small old plant (Martin furnace and rolling mill) of 50 to 100,000 tons annually.

carried out when preparing the First Regional Consultation on the Agricultural Machinery Industry in Africa 19/.

In most of the countries surveyed in Africa, the production achieved, as well as the forecasts for the production of agricultural machinery and tools, are very modest.

Table 19

Actual production and expected production of agricultural machinery and tools in several African countries 20/

COUNTRY	ACTUAL PRODUCTION (1978 or 1979)	EXPECTED OPTIMUM OR MAXIMUM PRODUCTION
MALI	Less than 1000 tons annually	Approximately 2000 tons annually
KENYA	Less than 2000 tons	Approximately 5000 tons (excluding tractor assembly)
SENEGAL	Approximately 2000 tons	Approximately 5000 tons
CAMEROON	Approximately 1500 tons	Approximately 2000 tons
MOZAMBIQUE	A few hundred tons	Approximately 3000 tons
ZAIRE	Approximately 2000 tons	3000 to 4000 tons
ETHIOPIA	Less than 500 tons	Approximately 500 tons 21/
BURUNDI	Production by traditional blacksmiths	Unused capacities of less than 150 tons
MADAGASCAR	Approximately 500 tons	Approximately 1000 tons 22/

19/ Addis Ababa (Ethiopia), 5-9 April 1982.

20/ Preparatory documents concerning 16 African countries.

21/ Excluding the production of nails, springs, barbed wire, etc.

22/ For each of these countries, it is the optimum or maximum production on the basis of existing plants or projects or projects under construction.

Imports of agricultural machinery by most African countries are also at modest levels. In 1974, which marks a high point, imports of agricultural machinery in the 11 countries of southern and East Africa amounted to 25,800 tons, or approximately 2000 tons per country 23/.

Regardless of the apparent simplicity of machinery and even (hand) tools in the case of agricultural equipment, there is still a gap between the products of which they are made (in form and quality) and the products supplied by the most elementary iron and steel plants.

A good illustration of this is provided by the components of two tractor-drawn machines.

Table 20

SISCOMA SWING-PLOUGH - 35 kg 24/

SUB-ASSEMBLIES	PRINCIPAL IRON AND STEEL COMPONENTS
Complete beam	Semi-hardened flat bars, 50 x 20 and 40 x 8
Ploughing body	Imported sub-assembly (composed of highly resistant steels: 95 kg/mm^2)
Stilts	Flat bars of 30 x 10 and 30 x 7 - tube: 32 x 1.25
Land wheel	Flat bars of 40 x 4 and 30 x 14 - tube: 33/42 and cast iron
Furrow-width adjuster	Flat bars of 30 x 14 and 40 x 12
Attachments and miscellaneous	Hook, chain, screws and bolts, etc.

23/ ECA/MULPOC/LUSAKA/IV, 26 November 1980.

24/ "Study on the Situation and Prospects of the Agricultural Machinery Industry in Senegal", page 82 bis. By Birame Ngoye Fall, UNIDO, November 1981. This refers to the manufactures of the SISCOMA Corporation in Senegal.

Table 21

SISCOMA WESTERN HOE 25/

SUB-ASSEMBLIES	PRINCIPAL IRON AND STEEL COMPONENTS
Double beam	Flat bars of 30 x 7, 30 x 12, 100 x 5
Stilts	Flat bars of 30 x 7; tube of 32 x 1.25
Land wheel	Flat bar of 40 x 4, 35 x 7, 30 x 12; tube of 33/42 plus cast iron
Assembly parts for tools	Flat bar of 50 x 6; bars of 6, 10, 12 and 20 - nuts and bolts
Swingle bar	Flat bar of 35 x 7; rolled piece of ø 10; steel plate of 4 mm
3-coulter cultivator	Flat bar of 30 x 12 - frame of 20 x 20 - Adx annealed plate of 3 mm - flat bar of 100 x 5
Ploughshares	20 x 12 flat bar - 20 x 20 treated steel frame

Among these components, the only ones to be produced by the projected iron and steel plant in Senegal 26/ would be the rolled pieces and bars, which would account for only a minute proportion of the parts used in manufacturing the Western Hoe.

The swing-plough and Western hoe are quite representative of all tractor-drawn machines. As for such hand tools as spades, dabas or machetes, they are also made from sheet or wide flat bars, i.e. flat products or such as can only be produced by complex iron and steel plants (sheet).

We find, therefore, that it is neither easy nor possible in the immediate future to establish any close relationship between the iron and steel industry, on the one hand, and the production of capital goods on the other. The iron

25/ Birame Nhoye Fall, op. cit., p.83.

26/ A project, incidentally, which is unlikely to be carried out very quickly.

and steel engineering industries develop along their own lines, which cannot be expected to converge except very gradually. There are problems of categories of iron and steel products (bars, sections, sheets, etc.) and qualities (semi-hardened, hardened, alloyed steels, etc.). In this connection, it has already been pointed out that the necessary attention to quality does not imply any "superstition" about quality as the result of blindly following Japanese or American standards. Moreover, it is necessary to take account of the current or predictable technical developments, which are characterized by a tendency towards miniaturization. However, the miniaturization which is currently concerned with the production of bars (micro-steel plants), bars and light or medium sections (mini-steel plants of 60, 80 to 400,000 tons annually) has not yet gone so far as to produce hot-rolled flat bars; in general, the capacity of the old Steckel rolling mills greatly exceeds 100,000 tons or even 200,000 tons per year. Even if the thin-slab casting process tested by US Steel and the Bethlehem Steel Corporation, which makes it possible to produce slabs 25 mm thick (and then hot-rolled sheet) directly by continuous casting should become operational before five years, it would be used in plants whose capacity, it seems, would not fall below 300,000 tons per year 27/, which for many developing countries leaves the problem unsolved.

It must also not be forgotten that the construction of capital goods in the developing countries (or Gross Fixed Capital Formation in national accounting terms) is composed both of capital goods proper (machinery and equipment) and construction projects which fall within the building and public works sector. Over a long compulsory period (several dozen years), the problem is to build up by stages increasingly close links between the iron and steel Industry and production which contributes to Capital Formation (GFCF).

Over successive periods (with possible overlaps), the iron and steel industry is first linked to the demand for infrastructures, gradually

---

27/ See Business Week of 24 September 1984. Kawasaki Steel in Japan is also said to be experimenting with a process of this kind.

including metal manufacture, and then to the production of equipment and machinery (capital goods) ranging from the simple to the complex. The production of equipment and machinery has its own logic, which is not only connected with supplying iron and steel products (and others) but also with the existence of drop-forging, smelting and machining facilities, as well as with the necessary professional qualifications of personnel 28/.

By taking due account of the various components of capital formation, in addition to the mere production of capital goods, it is possible to identify more clearly the stages and operation of a gradual overlapping between the two activities in question: iron and steel, on the one hand, and the engineering industries on the other.

Assuming that iron and steel products are divided roughly into 7 categories in accordance with a line of increasing complexity (S_1 to S_7), we find:

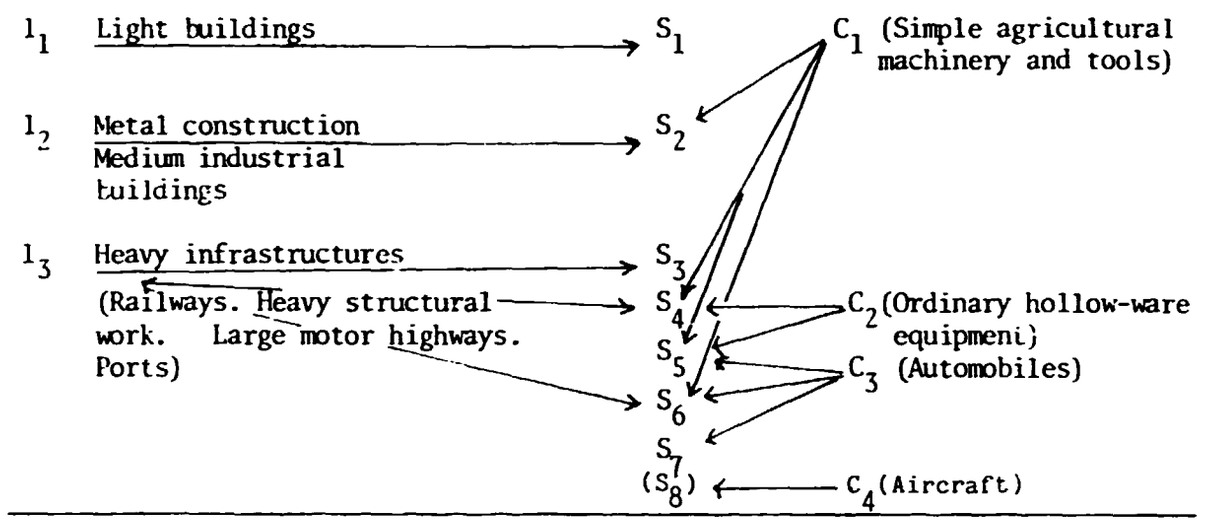
a = that if simple agricultural machinery and tools call for S_2, S_4 and S_6,

b = S_1, S_2 and S_3, on the other hand, find outlets in the construction of infrastructures of categories 1_1, 1_2, 1_3, etc.

28/ The proportion of steel used is:
- approximately 1/6 or 1/10 in the price of a tool or a simple agricultural machine;
- approximately 1/25 to 1/30 in the price of an automobile or a relatively complex machine.

Table 22

Dynamics of the relations between iron and steel and productions figuring in the construction of capital goods 29/



29/ S_1: ordinary long products: reinforcing bars - reduced range of dimensions

S_2: long products: reinforcing bars, light and mediur sections and small welded tubes

S_3: long products, heavy sections

S_4: hot-rolled sheet steel, large welded tubes

S_5: cold-rolled sheet steel, heavy sheets, galvanized sheets

S_6: high-quality steels of all shapes and seamless tubes

S_7: high-alloy steels of all shapes

S_8: alloys of aluminium, titanium, magnesium, etc.

The identification of this kind of relationships establishes a basis for the realistic definition of an approach which more completely covers the development of the iron and steel side of the capital goods industries in the developing countries, as well as a basis for preparing a typology of these countries from this point of view.

III. PROPOSED TYPOLOGY OF DEVELOPING COUNTRIES ON THE BASIS OF THEIR RESPECTIVE SITUATIONS WITH REGARD TO THEIR IRON AND STEEL AND CAPITAL GOODS INDUSTRIES

We have considered 91 developing countries, while excluding a few - generally of small size - concerning which the necessary information was not available.

The following criteria were adopted:

1. Criterion of population
2. Criterion of value added by engineering industries
3. Criterion of quantitative and qualitative level attained by iron and steel production capacities.

On the basis of these criteria, the 91 countries have been divided into five classes, characterized as follows:

Class I:
- less than 5 million inhabitants;
- value added by engineering industries less than US $ 20 million;
- capacity of iron and steel production: nil, or else one small rolling mill (micro-steel plant in two cases).

Class II:
- from 5 to 20 million inhabitants;
- value added by engineering industries between US $ 20 and 60 million;
- capacity of iron and steel production: majority of small rolling mills or semi-integrated steel plants.

Class III:
- more than 20 million inhabitants;
- value added by engineering industries between US $ 60 and 300 million;
- capacity of iron and steel production more than 100,000 tons annually (and often welded tubes).

Class IV:
- more than 20 million inhabitants;
- value added by engineering industries between US $ 300 and 2000 million;

- capacity of iron and steel production more than 500,000 tons annually (production of flat products, tubes and sometimes special steels).

Class V:
- more than 20 million inhabitants;
- value added by engineering industries more than 5 million tons (including seamless tubes and special steels).

These five classes of countries are presented in the following tables 30/.

30/ Information taken from Metal Bulletin: ILAFA Review; SEAISI QUARTERLY; Chambre Syndicale de la Sidérurgie Française, COFRANSID, Paris, etc.

Table 23

CLASS I

	NO IRON AND STEEL	SEMI-INTEGRATED UNIT	ROLLING MILL	LONG PRODUCTS	FLAT PRODUCTS HOT-ROLLED	FLAT PRODUCTS COLD-ROLLED	TUBES	SPECIAL STEELS	PRELIMINARY STUDIES
BENIN	x								
CENTRAL AFRICAN REPUBLIC	x								
CHAD	x								
CONGO	x								x
HONDURAS	x								x
LIBERIA	x								x
MAURITANIA		x(micro)		x					
GABON	x								x
PANAMA			x	x					
SIERRA LEONE	x								
NIGER	x								
TOGO		x(micro)		x					
SOMALIA	x								
COSTA RICA			x	x					
JAMAICA	x								
NICARAGUA			x	x					
GUINEA-BISSAU	x								
RWANDA	x								
BURUNDI	x								
EQUATORIAL GUINEA	x								
DEM. YEMEN	x								
MAURITIUS			x	x					x
QATAR		x		x					
ABOU DHAM			x	x					
DUBAI		x		x					
OMAN	x								x
TOTAL: 26	17	4	5	9					6

Table 24

CLASS II

	NO IRON AND STEEL	SEMI-INTEGRATED UNIT	ROLLING MILL	LONG PRODUCTS	FLAT PRODUCTS		TUBES	SPECIAL STEELS	PRELIMINARY STUDIES
					HOT-ROLLED	COLD-ROLLED			
AFGHANISTAN	x								x
ANGOLA			x	x					
GUINEA	x								
HAITI	x								
NEPAL	x								
MADAGASCAR	x								x
MALI	x								x
TANZANIA		x		x					
UGANDA		x		x					
UPPER VOLTA	x								
YEMEN ARAB REPUB.	x								
BOLIVIA	x								x
CAMEROON			x	x					x
SALVADOR		x		x					
SRI LANKA		x		x			x		
MOZAMBIQUE			x	x					x
SENEGAL	x								x
SUDAN	x								
ZAIRE		x		x					
ETHIOPIA			x	x					
GUATEMALA			x	x					
JORDAN		x		x			x		
LEBANON		x		x			x		
DOMINICAN REPUB.			x	x			x		x
TOTAL: 24	11	7	6	13			4		8

Jordan and Lebanon have less than 5 million inhabitants. On the other hand, the value added by their engineering industries is more than US $ 60 million, while their steel production capacities are already diversified.

Table 25

CLASS III

	NO IRON AND STEEL	SEMI-INTEGRATED UNIT	ROLLING MILL	LONG PRODUCTS	FLAT PRODUCTS HOT-ROLLED	FLAT PRODUCTS COLD-ROLLED	TUBES	SPECIAL STEELS	PRELIMINARY STUDIES
BANGLADESH		x		x			x		
BURMA		x		x					
MOROCCO			x	x					
SYRIA		x		x			x		
CUBA		x		x			x		
ECUADOR		x		x					
GHANA		x		x					
IVORY COAST			x	x					
KENYA		x		x					
TUNISIA		x		x		(x)	x		
ZIMBABWE		x		x			x		
ZAMBIA			x	x					
PARAGUAY		x		x					
TRINIDAD		x		x					
URUGUAY		x		x			x		
KUWAIT			x	x			x		
LIBYA		(x)		(x)	(x)	(x)	x		
HONG KONG		x		x			x		
TOTAL: 18		13(+1)	4	17(+1)	(1)	(2)	9		

( ) Projects under way.
HONG KONG, URUGUAY, PARAGUAY, TRINIDAD, KUWAIT and ZIMBABWE belong to this class because of the relative importance of their iron and steel plants and subsidiaries.

Table 26

CLASS IV

	NO IRON AND STEEL	INTEG- RATED UNIT	ROLLING MILL	LONG PROD- UCTS	FLAT PRODUCTS HOT-ROLLED	FLAT PRODUCTS COLD-ROLLED	TUBES	SPECIAL STEELS	PRELIM- INARY STUDIES
EGYPT		x		x	x	x	x		
DEM.REP. KOREA		x		x	x	x	x	x	
PAKISTAN		x		x	x	x	x	x	
IRAQ		x		x			x		
SAUDI ARABIA		x		x			x		
CHILE		x		x	x	x	x	(x)	
MALAYSIA		x		x	(x)	(x)	x(TSS)		x
PERU		x		x	x	x	x		
VENEZUELA		x		x	x	x	x(TSS)	x	
COLOMBIA		x		x	x	x	x(TSS)	x	
INDONESIA		x		x	(x)	(x)	x		
IRAN		x		x	(x)	(x)	x		
NIGERIA		x		x					x
PHILIPPINES		x		x	x	x	x		x
THAILAND		x		x			x	x	
SINGAPORE		x		x				(x)	
TOTAL: 16		16		16	8(+3)	8(+3)	15	4(+3)	4

( ) projects under way.
(TSS) - including seamless tubes.
SINGAPORE belongs to this class, in view of the diversity of its industrial activities.

Table 27

CLASS V

	INTEGRATED UNIT	LONG PRODUCTS	FLAT PRODUCTS		TUBES	SPECIAL STEELS	MACHINE TOOLS	SHIPBUILDING	AUTOMOBILES	AIRCRAFT	ELECTRONICS	ARMAMENTS
			HOT-ROLLED	COLD-ROLLED								
ARGENTINA	x	x	x	x	x(TSS)	x	x	x	x	x	x	x
BRAZIL	x	x	x	x	x(TSS)	x	x	x	x	x	x	x
CHINA	x	x	x	x	x(TSS)	x	x	x	x	x	x	x
TAIWAN	x	x	x	x	x	x	x	x	x	(x)	x	x
INDIA	x	x	x	x	x(TSS)	x	x	x	x	x	x	x
DEM. REP. KOREA	x	x	x	x	x(TSS)	x	x	x	x	x	x	x
MEXICO	x	x	x	x	x(TSS)	x	x	x	x	(x)	x	x
TOTAL: 7	7	7	7	7	7	7	7	7	7	5(+2)	7	7

(TSS) - including seamless tubes
( ) - manufacture of parts and sub-assemblies.

This typology shows that steel production capacities are - quantitatively and qualitatively - unequally divided.

Table 28

Steel production capacities in the developing countries, divided into 5 classes

	TOTAL CAPACITIES (in 1000 t/year)	CAPACITIES PER MILLION INHABITANTS (in 1000 t/year)
Class I	500	10.0
Class II	600	2.5
Class III	4 000	13.0
Class IV	30 000	55.0
Class V	120 000	60.0

Table 28 (continued)

	TOTAL CAPACITIES (in 1000 t/year)	CAPACITIES PER MILLION INHABITANTS (in 1000 t/year)
EUROPE (EEC)	200 000	740.0
JAPAN	150 000	1 400.0

This typology ought to be refined and supplemented by including in it, for example, a picture of the dynamics of capital goods, systematizing the first approaches made in Class V 31/.

Finally, this typology shows that Class III is a key category where we can see certain transitions and accelerations and which clearly reveals certain closer interconnections between iron and steel and the production of capital goods.

31/ See Annex I.

IV. FOR A MORE INTEGRATED APPROACH - PROBLEMS AND CONDITIONS

A more integrated approach to these two activities can be developed by meeting the following conditions:

(a) Shortening the distance which separates, during the first stages, ordinary iron and steel production from the production of even very simple capital goods by taking account not only of the production of capital goods but also, in a broader way, capital formation 32/, including the construction of infrastructures.

(b) Priority consideration not to be given to the sequential or hierarchic connection between the two activities but to the specific dynamics and logic of each activity.

The products of the iron and steel industry constitute one of the key factors - among others - of the machine processing industry, which is organized primarily on the basis of the capacities of ironworks, foundries, machine finishing and very high professional qualifications. For its part, the iron and steel industry does not necessarily develop in a linear direction, from the top down; it operates both by moving down (from steel plant to rolling mill) and by reascending (from cold-rolling mill to hot-rolling mill or from the tin-plating shop to cold-rolling, etc.).

An integrated approach will become effective in so far as it succeeds in identifying and accelerating the convergences between two original lines of dynamic evolution.

(c) Recognition of the fact that there are no "compulsory sequences" and "automatic follow-up effects". The historical experience of the Ruhr cannot necessarily reoccur again. Experience shows that the big iron and steel plants built in Italy and in France during the 1960s and 1970s at TARANTO

32/ In the sense of Gross Fixed Capital Formation.

and FOS DUR MER did not have any appreciable "follow-up" effect, while in BULGARIA, ever since 1950, the development of the engineering industry constantly preceded that of the iron and steel industry. It would seem that between the iron and steel and engineering industries (capital goods) it is more a question of reciprocal interactions, following their own original sequences, than of subordinate links due to rigid formulas.

(d) Questionable validity of regional approaches 33/, especially in Africa south of the Sahara, where the lack of available resources and the scattered location of steel and iron or engineering plants make it unlikely to expect any dynamic changes.

33/ In the sense of multinational regions, such as the States in Central Africa, for example (UDEAC).

V. FOR AN INTEGRATED APPROACH: ELEMENTS OF A RESEARCH PROGRAMME

(a) Supplement information which will provide a better understanding of the situation of the developing countries (at present and by 1990) with regard to:

- the field of the iron and steel industry: plants, production (quantitative and qualitative information) and projects:
- the field of the production of capital goods: installed capacities, present and potential production, projects, etc.

(b) Carry out studies of selected cases among each of the five classes of the proposed typology with a view to identifying dynamic sequences, reciprocal interactions and thresholds, obstacles and blockage.

The following cases might be selected:

Class I: Republic of Congo and Burundi (no steel plant); Cameroon (rolling mill); Togo (rolling mill and micro-steel plant).

Class II: Sri Lanka (Asia) and (or) Dominican Republic (Latin America).

Class III: (which is seen to be a key class) Tunisia and (or) Zimbabwe.

Class IV: Malaysia (or Indonesia) and Venezuela (or Colombia).

Class V: Republic of Korea and Brazil.

(c) Study relevant cases where very dynamic changes have taken place in the last 30 years:

- Finland joining the OECD
- Bulgaria joining COMECON.

(d) Evaluate the impact of technical (or technico-economic) changes, either now taking place or foreseeable by the end of the decade, on iron and steel production (miniaturization, new processes) as well as on machine production (new materials, automation, lasers, etc.) which are likely to encourage or, on the contrary, impede a dynamic movement in the metal and engineering sector in the developing countries (and especially in certain categories of developing countries).

ANNEX

SUGGESTED DYNAMIC FLOW OF CAPITAL GOODS AS INCLUDED IN A TYPOLOGY OF 5 CLASSES OF DEVELOPING COUNTRIES

Class I	Production of hardware, metal-work, ordinary metal beams, construction using extruded products.
Class II	Production of simple agricultural machinery, metal beams and small hollow-ware equipment, equipment for processing agricultural products.
Class III	Production of medium-size metal beams, simple standard or partially integrated capital goods, pumps, ventilators, electric motors, transformers, wheelbarrows, automobile bodywork and railway cars.
Class IV	Production of heavy metal beams, more complex hollow-ware equipment, standard capital goods, simple machine-tools, diesel engines. medium electrical equipment, small-scale shipbuilding parts.
Class V	Production of machine-tools, electronic equipment large-tonnage vessels, special machinery, automobiles, aircraft, heavy power equipment (turbines, alternators), marine engines, armaments.

LIST OF TABLES

LIST OF TABLES (continued)