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08028

Distr.
LIMITED

UNIDO/ICIS.70
3 May 1978

ENGLISH
ORIGINAL: FRENCH

UNITED NATIONS INDUSTRIAL
DEVELOPMENT ORGANIZATION

CAPITAL GOODS INDUSTRY *)

(Preliminary Study)

Prepared by the
International Centre for Industrial Studies

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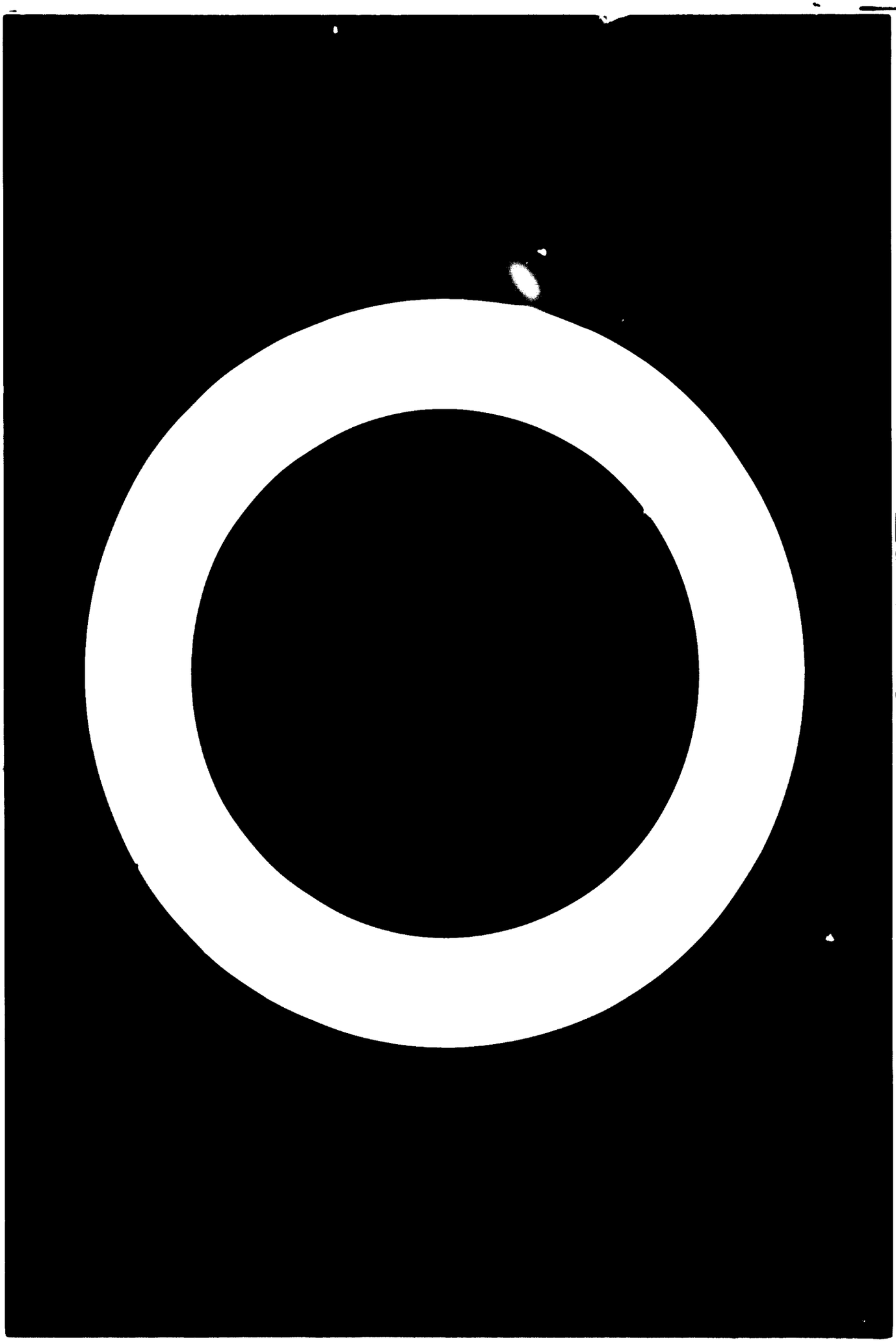
id.78-2351



C O N T E N T S

Summary and Conclusions

1) The present study,"Capital Goods Industry", produced in a very short time, has two objects:

   (a) to describe the problem and the development prospects for the capital goods industry;
   (b) to make it possible to design and organise a subsequent worldwide study of this industry.

2) Capital goods constitute a complex grouping, comprising millions of products, which are the basis for the accumulation of fixed capital. Its study therefore requires a methodology which is capable, initially, of ordering the principal facts. The choice of methodology which was made was intentionally orientated towards possible use and action at national and international levels.

   The classifications which were used derived from this option. They combine, in a three-dimensional representation:

   - The final demand, that is to say the sectorial use of capital goods;
   - The products as a function of technological routes, that is to say their method of production;
   - The developing countries, according to the existence or not of a capital goods industry or of the initial elements of the latter. Their interrelation leads to a first and, at this stage, broad typology of capital goods.

   It is proposed to continue to improve this instrument for analysis and action, and to divide the sector into sub-systems which are significant from the point of view of development policies.

3) The inadequacy of statistics is an obstacle when making a precise diagnosis of the situation. It is necessary to improve the statistical apparatus and to so arrange matters, for example, as to make 1980 an improved reference year.

The situation in the capital goods sector has been approached with the available information. Nevertheless, and irrespective of the reserves of a statistical nature which must be entered, and the corrections which remain to be made, these are not likely to be of such a nature as to modify the fundamental findings: 97 - 98% of capital goods are produced in the industrialised countries. The developing countries only contribute 2 - 3% of the production and 1.5% to world exports.

Only a few developing countries have a capital goods industry. Production is concentrated in five countries, Argentina, Brazil, South Korea, India and Mexico which produced 80% of the capital goods of the developing countries with a market economy. Finally six other countries, Chile, Columbia, Egypt, Pakistan, the Philippines and Singapore and the territory of Puerto Rico produced 12% of the capital goods.

The rest of the production, about 8%, is distributed between 12 countries: Algeria, Hong Kong, Iran, Malaysia, Morocco, Nigeria, Peru, Sri Lanka, Thailand, Tunisia, Turkey and Venezuela.

Finally 96 countries and 18 territories do not appear to have even an embryonic capital goods industry. Amongst these 34 countries and 18 territories have less than 1 million inhabitants, 50 have between 1 and 10 million inhabitants, whilst 12 have more than 10 million inhabitants.

These findings lead to the search for specific and realistic policies for the production of capital goods for each of the groups being considered.

4) The need has become particularly urgent for the group consisting of the smallest and poorest countries to analyse what production policy covering which capital goods is practicable.

The policy of basic needs which is recommended within the system of the United Nations could serve as a first criterion of expression of the final demand. It will be necessary then to examine the implications of this policy and the capital goods industry in the countries concerned.

Unfortunately there does not appear to exist, at the present time, any study on the corresponding structures between basic needs and the capital goods industry. It is proposed to carry out this, and the method of analysis involving interrelations between final demand - production routes - countries suggests that it is possible on the basis of this approach.

5) The existence of groups of capital goods common to varied uses in the final demand, of analogous classes of goods from the point of view of their production, suggest new approaches for the strategy of entry of developing countries into these activities and for the evaluation of investment projects by groups of analogous products rather than product by product.

6) The recognition by the international community of a need to create and to develop a capital goods industry in the developing countries is the principal question to be discussed.

In fact the absence of a capital goods industry is without doubt one of the most significant indicators of under-development.

The new economic order to be constructed can not be based on a prolongation of the present international division of labour. There are many reasons for this.

- Without a capital goods industry the developing countries, even if they achieve rates of industrial growth corresponding to the objectives of the Lima Declaration, cannot escape from their dependence. The latter will in fact be accentuated by industrialisation. Their industrial fabric will depend exclusively on the industrial and technological centres of the industrialised countries. Internal integration of industries, and even sub-regional integration, would be almost impossible.

The problem is therefore a political one. It does not relate to interdependence - which is a state of fact - but on the selection of its modalities, whether weak or strong.

- The capital goods industry, by its direct action and by the indirect measures needed for its environment, is a motive force behind development. It creates the conditions not only for the exploitation of the industrial system, but also for its self-reproduction.

In other terms the establishment of a capital goods industry is one of the essential conditions for avoiding pseudo-transfers of technology - that is to say their use without their assimilation. Because it involves the domination of a large range of technologies the capital goods industry, and the engineering infrastructure associated with it, therefore makes it possible to escape from a mimetic mode of transfer and so opens up the way for the creation of local capacity for innovation. The essential condition

for the realisation of "appropriate technologies" is the establishment of the growing points for a capital goods industry and of Research and Development capacities. Technologies with an intensive labour content which incorporate less fixed capital are not generally produced in the industrialised countries - and there is little prospect that they will be produced there in the coming decade. This task can, definitively, only be carried out by capital goods industries in the developing countries themselves.

- The capital goods industries, taken overall, have the characteristic of being relatively inexpensive in terms of fixed capital investment for each job created. From this point of view they are not such "heavy" industries as, for example, iron and steel production and agribusiness. Their establishment and development therefore contributes substantially to the fight against unemployment and under-employment in many developing countries.

But it is these industries, by contrast, which require highly skilled labour. Improving the skills of labour could, at the same time, form in itself an objective, since its realisation would contribute towards reducing those inequalities which exist between the industrial countries and the developing countries. The availability of skilled labour requires not only specific "training" actions, but also an adequate educational level. The basic training provides the "entrance ticket" into the capital goods industry activity. This implies the consequent orientation of the educational system in the developing countries.

- The very logic of the Lima Declaration involves envisaging the establishment and development of capital goods industries in the Third World countries.

In practice the realisation of the Lima objectives would signify a rapid growth in manufacturing production, a sudden break with the rates observed in the past. There would follow a demand for capital goods which would be proportionately even greater. If this demand can only be met by imports this will result in trading balance deficits which will undoubtedly be insoluble. It is therefore essential that part at least of the equipment should be produced locally.

7) An initial exploration into the future leads to establishing the probable orders of size of what could be the growth of the capital goods industries in the developing countries and the consequences for international trading.

The use of the UNCTAD and UNIDO models (World Industry Cooperation Model) shows that the general objective of 25% set out in the Lima Declaration is excluded in the capital goods sector. However in the year 2000 a proportion of the order of 15% of world production of capital goods in the developing countries would be coherent with the overall objective. These projections, irrespective of the hypotheses, also suggest that the industrialisation of the Third World would constitute an enormous outlet for the capital goods industries in the industrialised countries, and so an essential factor in the advancement of their economies.

In this way, and according to the hypotheses of the UNIDO model, net exports of capital goods from the industrialised countries to the developing countries would be equivalent - despite the local production which is envisaged - to 40% to 60% of their 1970 production (as against 4% at the present time). This therefore involves a major modification in the structure of international trading, with mutual benefits.

8) The future will depend on the projects of the international partners, the compatibility or incompatibility of these, and on the degree and modalities of these cooperations. The image of the year 2000 cannot therefore result from mechanical projections of past trends. Whilst the latter may form a useful background canvas for reasoning the postulate that the future will be a continuation of the past cannot be sustained. It is therefore necessary to move on to prospective projections.

This implies explicitly taking into account the actors concerned, their projects and their strategies, together with the identification of the strategies which concretely indicate the objectives, problems, constraints and means of action of the principal actors.

It is on the basis of the identification of these strategies that the hypotheses of development of the essential variables in the capital goods sector can be formulated and put forward for discussion.

The retained hypotheses then form coherent combinations which define the various scenarios which may be envisaged.

9) A proposal for a programme of studies has therefore been drawn up so as to establish the logistic base for the Consultations process and for the instruments of action for the national policy makers.

As a consequence therefore the studies should be pursued in the following domains:

- i) Further work and splitting of the typology of capital goods to make the typology more operational.

- ii) Conceptualisation and measurement of the degree of technological complexity of capital goods.

- iii) Correspondences between technical complexity in the capital goods sector and the curricula of the educational system.

- iv) Technological forecasts of the development which can be envisaged from now until the year 2000 in key groups of the capital goods industry.

- v) Synthesis of the information on capital coefficients by industries and the development thresholds.

- vi) The repercussions of a policy of basic needs on the corresponding demand for capital goods.

- vii) Continuation of research work on strategies for the entry and expansion of developing countries in the activities of the sector:

    - Analysis of products common to all the branches,

    - Organisation of the productive apparatus according to the strategies of standard workshops, integrated production units, technological production groups and the re-grouping of analogous products,

    - The development of the national and international environment of national capital goods industries, these being prerequisite conditions,

- Advances in national engineering in the developing countries.

- viii) Evaluation of the direct and indirect costs of job creation.

- ix) Analysis of types of industrial arrangements practised in the production of capital goods, and the specific characteristics of technological transfers.

- x) Improvement of the statistics.

This study programme, which will obviously require time, would be activated in order to supply the most urgent additional elements to the present preliminary study, particularly in subjects i, ii, iv, vi, vii and viii.

It should be linked with the studies proposed, in this field, by various Regional Commissions of the United Nations.

Its realisation implies, and in particular in subjects ii, iii and iv, collaboration outside the ICIS with research institutions in the most advanced industrialised countries and, in the case of subjects vi and vii, close collaboration with representative developing countries in each of various groups considered in this study.

CHAPTER I

THE PROBLEM AND PROSPECTS FOR THE DEVELOPMENT OF THE CAPITAL GOODS INDUSTRY

I - DIAGNOSIS OF THE PRESENT SITUATION

1. Making a diagnosis of the capital goods industry encounters numerous difficulties.

   a) There is no correspondence between the generally accepted economic definition and the industrial statistics. By capital goods is effectively understood the sector producing goods which contribute to gross fixed capital formation in agriculture, industry, services and administration.

   This sector is therefore only a part of the metal converting industry or of the engineering and electrical industries which produce not only capital goods but also intermediate goods and durable consumer goods.

   b) World industrial statistics covering the whole of the engineering and electrical industries sectors (ISIC 38) do not make it possible to isolate capital goods.

   c) International trading statistics are more sub-divided and, at the cost of some approximations, do make it possible to identify more clearly the capital goods sector, (parts of 69, 7 and 861 of the CTCI).

   d) Official industrial statistics remain based on an exhaustive inventory of the situation in 1963, on the basis of which the annual indices are applied. The published official statistics stop at 1970. A 1970-1974 series is available at UNIDO, but is not published by the United Nations. Statistics exist for international trading in 1975.

c) The available figures cover all the developing countries with information which is relatively reliable for Latin America and Asia but is less reliable for Africa, particularly because of the very low level of production.

2. The solutions adopted in this study, as a consequence, have been the following:

a) To attempt to define accurately those classes of capital goods in the existing industrial nomenclature. This is the subject of the proposals in Chapter II.

b) To use the available statistics covering the whole of the electrical and engineering industries and the projection models of UNCTAD and UNIDO. In this latter case it has been possible to approach reality in the capital goods sector more closely.

These are only approximations, but the alternative is either to abandon fixing orders of magnitude or, by accepting some inaccuracy, to avoid blocking possible analyses. It is the latter decision which was taken.

3. With these provisos it is possible to identify some basic data:

a) In 1970 world production of the engineering and electrical industries was estimated (in terms of added value) at $ 300 billion. If we consider all the engineering and electrical industries as representative of the capital goods sector the distribution of world product on in 1970 was as follows: (see Table 1).

- The developing countries account for 3.1% of capital goods. This production was realised by only about a dozen countries in Latin America and Asia.

- The market economy developed countries produced 60.3%.

- The planned economy countries produced 36.6%.

b) The corresponding proportions in 1955 were 2.1% for the developing countries, 79.1% for the market economy developed countries and 18.8% for the planned economy countries.

c) In the case of the market economy countries there has therefore been a relative falling back to the benefit of the planned economy countries. The change in the developing countries is not negligible in relative terms, but the absolute proportion remains very small. It is certainly even greater if one takes into account the fact that the overall statistics for the engineering and electrical industries include consumer goods (in particular automobiles), the production of which has increased more in the developing countries than that of capital goods. The overall order of magnitude of the contribution of the developing countries would therefore be between 1 and 2% of the world production.

d) Only a few developing countries have a capital goods industry. If one classifies these countries as a function of the number of workers in the mechanical machinery industry (class 382 of the CITI) one finds that:

. 5 countries (Brazil, India, Argentine, Mexico, South Korea) produce 80% of the capital goods of the developing countries,

. and the following 7 countries (Pakistan, Egypt, Singapore, Philippines, Chile, Colombia and Puerto Rico) produce 12% of the capital goods.

In 1970, therefore, 12 countries produced 92% of the capital goods in the developing countries.

e) In terms of jobs a total of about 2.7 million jobs were listed in 1970 for the engineering and electrical industries in the developing countries, 27.8 million in the market economy developed countries and 17.5 million in the planned economy countries (Table 2).

The contribution of this employment to total industrial employment was only 13% in the developing countries as against 26% in the planned economy countries and 26% in the market economy countries (Table 3).

f) It can be seen that the proportion in jobs in the developing countries (5.6%) is higher than that of the production (measured in terms of added value: 3.1%). This difference is explained by the lower productivity of the labour force.

In this way the added value for each job in the developing countries is of the order of half that in the industrialised countries, or of the order of $ 3,545 per job as against $ 6,000 to $ 6,500 in the industrialised countries, the differences being very considerable between continents and countries:

Latin America	: $ 6,010 per job
Asia	: $ 1,803 per job
Africa	: $ 1,202 per job
Brazil	: $ 5,878 per job
South Korea	: $ 1,508 per job
India	: $ 1,081 per job

Labour productivity is increasing more rapidly in Latin America than in Asia.

g) The elasticity coefficients between the growth of the engineering and electrical industries and that of the whole of manufacturing production also shows differences between the developing and developed countries (see Table 5).

During the period 1960-1970 the coefficients were 2 for Asia (11.0%/5.5%) and 1.41 for Latin America (9.2%/6.5%). During the period 1970-74 these coefficients were 1.57 (11.3%/7.2%) for Asia and 1.79 (14.0%/8.8%) for Latin America. No figures are available for Africa.

b) Consumption in 1970 was estimated by considering that the value of the gross production of the engineering and electrical industries was equal to twice the net production (added value) (Table 6).

The per capita consumption in 1970 can be estimated at $ 21 (current value) per inhabitant in the developing countries as against $ 559 for the planned economy countries and $552 for the market economy developed countries.

Consumption was evaluated at $ 17 (in current value) in 1964 for all the developing countries, including $ 10 for Asia, $ 12 for Africa and $ 49 for Latin America.

Production in the developing countries appears to have been 49.3% of their consumption in 1970, imports accounting for 50.4% of the consumption (Table 7).

In fact these latter evaluations are even more approximate than the previous ones. As has already been said the production of the electrical and engineering industries covers more than capital goods. The same applies to imports, which also include intermediate goods. The rising prices of imported capital goods inflates the apparent volume of consumption, and it is not possible to determine if the factors of statistical distortion between production and consumption compensate for each other. The prevailing impression is, however, that the extent of self-supply in the developing countries on the basis of their own production of capital goods is less than the proportions calculated for all the capital goods industries.

i) International trading is also marked by a very considerable dissymmetry.

- In 1970 exports from the engineering and electrical industries (class 7 of the CTCI) were evaluated at slightly less than $ 90 billion. They represented about 15% of the world production ($ 300 billion in terms of added value, multiplied by 2 to obtain an estimate of the gross value).

  Out of this total the market economy countries of OECD accounted for 85 to 90% of the world exports. In 1974 two countries were very much in the lead, the USA (19%) and West Germany (17.4%), followed by Japan (11.4%), France (7.9%), the United Kingdom (7.6%) and Italy (5.1%).

- The planned economy countries account for slightly less than 10% of world exports.

  As far as the developing countries are concerned these [illegible]nt for only 2% of world exports of engineering and ele[illegible] products.

Taken overall the positions of the major exporting countries were maintained during the period. In this way the eight leading exporting countries of capital goods retained the same share of the world market between 1963 and 1975 (75.12% in 1963, and 75.58% in 1975). There have however been considerable changes within these eight countries. The leading four countries saw their share drop by 4%, whereas that of Japan increased considerably (from 4.15% in 1963 to 11.41% in 1975), whilst at the same time that of the United Kingdom fell. The four other countries saw their share increase by more than 5% (see Table 8).

One can also detect a trend towards some diversification in exports. For example the three leading countries (USA, West Germany and the UK), which accounted for 55.69% of world exports in 1963, accounted for only 44.04% in 1975. This reduction in the share of the three leading countries (particularly the United Kingdom) has been compensated for by the growing share of Japan and the other OECD countries. By contrast the share of the planned economy countries is falling.

As far as the developing countries are concerned the concentration of exports is also very considerable. Exports from the developing countries come from only a few countries. Their policies do, however, appear to be quite different (see Table 9).

Singapore, Hong Kong and Korea primarily export electrical products (50 to 80%). These products are mainly electronic components, the manufacture of which requires fairly unskilled and cheap labour.

Brazil, Argentine and India export engineering products and means of transport, which are products with a much higher added value.

The policies concerning the countries of destination (Table 10) are also quite distinct:

- countries exporting mainly to the market economy developed countries; examples of these are Korea and Hong Kong which export 70% to this zone;

- countries exporting to both the developed countries and also to the developing countries:

  . Brazil exports 50% to Latin America and 26% to the OECD countries;

. Singapore exports 37% to the Far East and 26% to the USA:

- countries exporting mainly to developing countries:

. India exports 76% to these countries, 36% in its own region, 20% to the Middle East and 20% to Africa.

If we relate products to the zones of destination it can be seen that exports have a tendency to go to one of two destinations:

- the more sophisticated machinery and the means of transport are sold mainly to the developing countries (as in the case of Brazil, Argentine and India),

- various manufactured articles and light industry products of the component type are sold mainly to the industrialised countries (as in the case of Korea, Hong Kong and Singapore).

In the case of Brazil, Argentina and India the process of industrialisation has resulted in a very wide range of products, intended mainly for the domestic market and then for exports, and this explains how these countries have come late to exporting and the fact that they are able to export a range of more sophisticated products.

On the contrary Singapore, Hong Kong and South Korea (which is certainly developing rapidly) have not sought to develop their industry on such a wide scale but have followed a policy of development essentially directed towards the outside world by exporting products of low added value and high labour content, the demand for these being considerable in the industrialised countries.

- The imports of the market economy developed countries account for more than 65% of world imports.

  Planned economy countries import slightly more than 10%.

  The developing countries import slightly less than 25% of world imports.

- It follows from this that, around 1970, the trading balance of the engineering and electrical industries in the market economy industrialised countries was in credit, more or less balanced in the case of the planned economy countries, but obviously very much in deficit in the developing countries.

  Of the imports of the developing countries 90% (see Tables 11 and 12) come from the market economy developed countries. If a comparison is made between the importing zones and the various suppliers it can be seen that:

  . Africa imports mainly from Europe and from the USA,

  . The Middle East imports mainly from the USA and from West Germany,

  . The Far East imports mainly from the USA and from Japan,

  . Latin America imports mainly from the USA.

- Imports from the planned economy countries accounted for only 5.7% in 1973, a value similar to that of the imports from the developing countries themselves.

The existence of more detailed and more up-to-date statistics concerning foreign trading makes it possible to arrive at other findings:

The most dynamic markets during the period 1972-1975 were those in the developing countries.

Table 13 shows that whilst imports (in current dollars) over the whole world were multiplied by 2 they were multiplied by:

2 to 2.2 in Latin America
2.2 to 2.3 in the Far East (excluding Japan)
2.6 to 2.8 in Africa
3.7 to 4.2 in the Middle East

whereas the increase was considerably lower than 2.0 in the market economy developed countries and was 2.0 in the case of the planned economy countries.

Analysis of the markets relating to certain products (Table 14) show that:

- for production range products bought from catalogues, such as utility vehicles and public works machinery, the contribution of imports into the developing countries to total world imports was 50%;

- for custom-built products, such as electrical energy distribution equipment (electricity power stations and networks) one can also see the importance of markets in the developing countries, which account for 45 to 50% of the world imports.

By contrast in the case of consumer goods, represented in Table 11 by television receivers, it can be seen that the market is located mainly in the developed countries which import part of these products from low labour cost zones.

The increase in imports of engineering products (CTCI 71) by the developing countries when classified according to their per capita Gross National Product or their size[1] also shows interesting phenomena:

- It can be seen that in 1975 the petroleum exporting countries accounted for 35.6% of the imports of the developing countries, as against 21.4% in 1970. Imports increased by a factor of 6, whereas the mean was 3.7.

  Countries which already had an engineering industry represented 21% of the imports.

  All the other countries (63 + 45 small countries) represented 44% of the imports. In this bloc it can be seen that countries of less than $ 250 per capita, which account for 28% of the total population of the developing countries, account for only 10% of the imports. These countries effectively correspond to those with populations of more than 10 million (20.9% of the imports as against 31.5% of the population) (see Tables 15 and 16).

4. These basic data have the following implications for the latter part of this study:

   - firstly they show that it is necessary to approach projections with great caution. The initial statistical imprecision will be found to be accentuated. Within the order of magnitude observed it is therefore necessary to consider first of all the possible problem and the logic of the situations rather than the results in the strict sense of the word;

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(1) according to a simplified typology which is set out in greater detail in Chapter III.

- finally they lead, in the absence of statistical isolation of capital goods which is impossible at the present time on a world scale, to an attempt to avoid the obstacle and to attempt to penetrate the complex universe - the system - of capital goods, to examine it "from the inside" in its systemic reality. It is this which will be the subject of Chapter II;

- finally, and observing the major disparities of situation within the Third World countries, they lead to characterising the latter by means of a typology which, concentrating on the essential phenomenon of the capacity for self-production of fixed capital is, by itself, a first element in a typology of development or, according to the point of view, of under-development. This information is collected together in Chapter III.

E.E.C.

The rôle and place of the engineering and electrical industries in national economies and the world economy. Vol. I. United Nations 1974.

Table 1

Structure of world production of products by the metallurgical, engineering and electrical industries 1955-1970 (as percentages)

Regions	1955	1960	1965	1970
World a/	100.0	100.0	100.0	100.0
of which:				
Planned economy countries b/	18.8	26.9	30.9	36.6
Market economy countries	81.2	73.1	69.1	63.4
of which:				
Market economy developed countries c/	79.1	70.4	66.1	60.3
Market economy developing countries d/	2.1	2.7	3.0	3.1
North America e/	49.5	39.3	37.5	29.8
Caribbean, Central and South America	1.4	1.9	1.8	2.0
Africa	0.4	0.4	0.5	0.4
Africa, excluding South Africa	0.2	0.1	0.2	0.2
Asia f/	1.7	3.9	5.1	9.2
Asia f/, excluding Israel and Japan	0.5	0.7	1.0	0.9
Europe - Market economy developed countries	27.2	26.6	23.2	21.2
European Economic Community	13.8	14.6	12.7	12.2
European Free Trade Association	12.8	10.9	9.1	7.6
Other European countries	0.5	1.0	1.3	1.3
Oceania g/	1.0	1.0	1.0	0.8

Note:

The above figures are subject to subsequent confirmation.

Structure of world production in value added employment and added value per person employed in the manufacture of metal products, machinery and equipment (I.S.I.C. 38) by regions in 1970

Table 2

REGION	Added value (1)		Employment (2)		Added value per employed person
	US $m	%	Millions	%	US $m
Market economy countries	182,756.6	60.9	27.8	59.9	6573.9
Planned economy countries	108,199.8	36.0	17.5	36.5	6182.8
Developing countries	9,571.5	3.1	2.7	5.6	3545.0
of which					
Asia	2,704.7	0.9	1.5	3.1	1803.1
Latin America	6,010.5	2.0	1.0	2.0	6010.5
Africa	601.0	0.2	0.2	0.5	1202.0
WORLD	3[illegible],527.9	100.0	48.0	100.0	6260.9

Sources: (1) Study of industrial developmen[illegible] ited Nations, Vol. V, 1973

(2) Yearbook of industrial statisti[illegible] 1974 edition.

E.E.C.

The rôle and place of the engineering and electrical industries in national economies and in the world economy. Vol. I. United Nations 1974.

Table 3

Contribution of employment in the metallurgical, engineering and electrical industries as a percentage of overall industrial employment, 1955-1970

Regions	1955	1960	1965	1969	1970
World a/	23.8	25.3	27.0	28.1	...
of which:					
Planned economy countries b/	31.3	31.8	35.1	35.9	36.2
Market economy countries	21.8	23.5	24.6	25.7	...
of which:					
Market economy developed countries c/	28.6	30.9	32.8	34.3	34.8
Market economy developing countries d/	8.6	10.5	11.9	12.9	...
North America e/	32.3	32.7	35.0	36.8	35.8
Caribbean, Central and South America	15.2	16.5	17.7	17.6	...
Africa	4.6	9.3	12.4	12.8	
Africa, excluding South Africa	1.4	5.1	9.7	11.7	...
Asia f/	10.0	13.7	15.3	17.5	...
Asia f/, excluding Israel and Japan	6.9	9.0	10.4	11.7	...
Europe - Market economy developed countries	29.0	31.3	32.9	33.5	34.4
European Economic Community	28.6	31.1	33.1	34.4	35.3
European Free Trade Association	32.9	34.4	35.8	36.9	37.3
Other European countries	15.5	21.5	23.6	22.4	24.0
Oceania g/	28.9	31.5	33.6	34.3	...

Breakdown of employment according to the main categories of products in manufacturing of metal products, machinery and equipment (I.S.I.C.38) in developed market economies and in developing countries in 1970

Table 4

Main categories	Metal products except machinery etc. ISIC 381		Machinery except electrical ISIC 382		Electrical machinery apparatus etc. ISIC 383		Transport equipment ISIC 384		Professional photographic goods etc. ISIC 385		TOTAL ISIC 38	
	Millions	%	Millions	%	Millions	%	Millions	%	Millions	%	Millions	%
Developed market economies	5.31	19.1	8.04	28.9	7.02	25.2	6.14	22.2	1.27	4.6	27.78	100
Developing countries	0.71	26.9	0.64	24.3	0.58	22.0	0.58	21.9	0.13	4.9	2.64	100
of which												
Asia	0.39	26.0	0.42	28.0	0.36	24.0	0.26	17.3	0.07	4.6	1.50	100
Latin America	0.25	25.5	0.21	21.4	0.20	20.4	0.27	27.5	0.05	5.2	0.98	100
Africa	0.07	43.7	0.01	6.3	0.02	12.5	0.05	31.2	0.01	6.3	0.16	100

Source: Yearbook of industrial statistics. 1974 Edition

Growth of production and employment in manufacturing of metal products, machinery and equipment (I.S.I.C. 38) as compared with all industries (ISIC 3) in developing countries in Asia, Latin America and in Africa - 1960-1974

Table 5

Region	1960-1970				1970-1974			
	All industries ISIC 3		Metal products etc. ISIC 38		All industries ISIC 3		Metal products etc. ISIC 38	
	Rate of increase	Annual rate of growth %	Rate of increase	Annual rate of growth %	Rate of increase	Annual rate of growth %	Rate of increase	Annual rate of growth %
PRODUCTION								
Asia	1.7	5.5	2.8	11.0	1.32	7.2	1.54	11.3
Latin America	1.88	6.5	2.43	9.2	1.40	8.8	1.67	14.0
Africa	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
EMPLOYMENT								
Asia	1.38	3.2	1.81	6.1	1.22	5.1	1.25 (1973)	5.7
Latin America	1.33	2.9	1.42	3.6	1.15 (1973)	3.5	1.21 (1973)	4.9
Africa	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Source: Based on index numbers on industrial production and employment in Statistical Yearbook 1975 - United Nations.

World production, added value, international trade and consumption of metal products, machines and equipment (I.S.I.C. 38 & S.I.T.C. 7) by regions in 1970

Table 6

Region	Population (d) 1972		Production (e)		Added value (a)		Exports (b)		Imports (c)		Consumption		Per capita consumption
	Millions	%	US $m	%	US $m	%	US $m	%	US $m	%	US $m	%	US $
Developed market economies	662	22.9	365,513.2	60.9	182756.6	60.9	77773.2	87.8	58035.0	65.6	345775.1	57.5	522
Planned economies	387.0	13.4	216,399.6	36.0	108199.8	36.0	9478.1	10.7	9583.0	10.8	216504.5	36.0	559
Developing countries	1845	63.7	19,143.0	3.1	9571.5	3.1	1,328.7	1.5	20962.0	23.6	38776.2	6.5	21
WORLD	2894	100	601,055.8	100	300527.9	100	88580.0	100	88580.0	100	601055.8	100	207

Sources: (a) Study of industrial development, United Nations, Vol. V, 1973
(b) Study of industrial development, United Nations, Vol. V, 1973, page 45
(c) Bulletin of statistics on world trade in engineering products. Economic Commission for Europe 1970, United Nations.
(d) World Bank Atlas, 1974
(e) Estimated at double the added value

Different ratios in relation to production, consumption and international trade in metal products, machinery and equipment by regions - 1970

Table 7

Region	Per capita consumption dollars	Imports / Consumption (%)	Exports / Production (%)	Production / Consumption (%)
Developed market economies	522	16.7	21.2	105.7
Planned economies	559	4.4	4.4	99.9
Developing countries	21	54.0	6.9	49.3

Source: The ratios are calculated by using the statistics given in

- Study of industrial development - United Nations, Vol. V, 1973
- Bulletin of statistics on world trade in engineering products - E.C.E. United Nations, 1970

Countries exporting capital goods
(SITC Rev. Section 7)
Developments from 1963 to 1975
Table 8

Source: Bulletin of Statistics on world trading in products of the engineering and electrical industries. United Nations Economic Commission for Europe.

Country	1963	1970	1975
- United States	22.71	19.99	19.03
- Federal Republic of Germany	18.93	17.77	17.42
- Japan	4.15	8.76	11.41
- United Kingdom	14.05	8.86	4.59
Sub-total	59.84	55.38	55.45
- France	6.00	6.56	7.87
- Italy	4.36	5.44	5.08
- Canada	1.79	5.87	4.03
- Sweden	3.13	3.02	3.15
Sub-total	15.28	20.89	20.13
Sub-total for the 8 leading countries	75.12	76.27	75.58
- Belgium, Luxembourg	2.32	2.76	2.80
- Holland	2.90	2.58	2.73
- USSR	4.09	3.16	2.33
- German Democratic Republic	3.13	2.51	2.05
- Switzerland	2.06	1.82	1.92
Sub-total	12.44	12.83	11.83
Sub-total for the 13 leading countries	87.56	89.10	87.41
Other OECD countries			
- Austria	0.74	0.77	0.86
- Denmark	1.10	0.99	1.05
- Norway	0.42	0.04	0.98
- Spain	0.17	0.52	0.82
- Finland	0.42	0.43	0.52
Sub-total	2.85	3.35	4.23
Other planned economy countries			
- Bulgaria	-	0.65	0.76
- Czechoslovakia	3.33	2.11	1.55
- Poland	1.73	1.50	1.64
- Yugoslavia	0.43	0.43	0.48
Sub-total	5.49	4.69	4.43

Table 9 - Exports of engineering, electrical and transport products by some developing countries in 1975

COUNTRY	Engineering SITC 71		Electrical SITC 72		Transport SITC 73		Total	Annual rate of growth over the period 1970/75
	US $m	%	US $m	%	US $m	%		
Singapore	375	31	620	51	224	18	1220	48.2
Brazil	425	48	171	19	298	33	896	35.2
Korea	76	11	440	63	183	26	700	63.5
Hong Kong	98	15	562	83	11	2	672	22.9
Argentine	214	54	38	9.5	146	36.5	399	43.4
India	134	42	77	24	106	34	317	27.3

Table 10 - Exports of engineering and electrical products (SITC 7) from some developing countries - 1975 - (As percentages by destination zone)

Origin \ Destination	USA	JAPAN	WESTERN EUROPE	EASTERN COUNTRIES	MIDDLE EAST	AFRICA	LATIN AMERICA	FAR EAST (excluding JAPAN)
Korea	36	20	11	0	3	13	0	8
Singapore	26	3	18	0	4.5	2	1	37
Brazil	13	3.5	10	0	1.2	12	51	2
Argentina	3	3	5.6	0	0.3	1.5	85	0.6
India	1	0.5	12	8	20.4	20	1	36
Hong Kong	48	1	28	0	0.4	0.4	0.3	10

Table 11 - Origin of imports of developing countries

(Class 7. CTCI - Machinery and transport equipment

	1960 US $m	%	1970 US $m	%	1973 US $m	%
Market economy developed countries	7,590	94.5	17,270	89.0	31,360	89.6
Communist countries of Eastern Europe	300	3.7	1,500	7.7	2,010	5.7
Developing countries	135	1.8	640	3.3	1,620	4.7
Total	8,025	100	19,410	100	34,990	100

Handbook of international trade and development statistics 1976, UNCTAD.

Table 12 - Changes in the principal suppliers to the under-developed zones between 1972 and 1975 (as percentages)

Importing zones	Suppliers	Mechanical engineering SITC 71		Electrical engineering SITC 72	
		1972	1975	1972	1975
Africa	U.S.A.	14	17.4	8.3	9.4
	F.R.G.	16	18.2	12	15.2
	France	14	17.4	22	23.5
	G.B.	20	15.5	20	15.3
	Japan	3.8	4.5	9	10.1
	Italy	9	8.3	8	5.9
	U.S.S.R.	0.6	1.8		0.4
Middle East	U.S.A.	24	23.2	16	17.5
	F.R.G.	16	20.1	17	17.0
	France	7	7.3	7	6.9
	G.B.	16	12.5	14	15.2
	Japan	7	8.8	14	16.1
	Italy	7	6.9		5.6
	U.S.S.R.		4.0		0.9
Far East (excluding Japan)	U.S.A.	28	21.6	30	26.3
	F.R.G.	13	12.2	8	9.3
	France		4.9		3.7
	G.B.	9	8.7	8	6.3
	Japan	23	29.6	36	32.9
	Italy		2.6		1.3
	U.S.S.R.	7	5.0		2.0
Latin America	U.S.A.	40	40.8	39	40.4
	F.R.G.	16	13.2	10	7.7
	France		4.0	6	5.6
	G.B.	8	6.8	5	3.6
	Japan	6.5	7.6	13	11.7
	Italy	8	6.9		4.9
	U.S.S.R.		2.4		2.0

Table 13 - Growth of imports of engineering and electrical products, by zones

ZONES	ENGINEERING PRODUCTS SITC 71					ELECTRICAL PRODUCTS SITC 72				
	1972		1975		1975/1972	1972		1975		1975/1972
	US $bn	%	US $bn	%		US $bn	%	US $bn	%	
MARKET ECONOMY DEVELOPED COUNTRIES										
U.S.A.	4,242	8.2	6,559	6.4	1.55	2,643	11.4	4,037	8.7	1.5
Japan	1,144	2.2	1,649	1.6	1.44	328	1.4	700	1.5	2.1
Western Europe	21,791	42.5	39,087	38.4	1.80	11,032	47.6	20,884	45.0	1.89
COMMUNIST COUNTRIES	7,634	15.0	14,982	14.7	2.0	1,837	7.9	3,552	7.7	1.93
DEVELOPING COUNTRIES										
Africa	2,859	5.5	7,507	7.4	2.60	1,176	5.1	3,272	7.1	2.8
Middle East	1,665	3.2	7,030	6.9	4.20	853	3.7	3,142	6.8	3.7
Far East (excluding Japan)	3,352	6.5	7,808	7.7	2.30	1,889	8.2	4,169	9.0	2.2
Latin America	4,119	8.0	9,155	7.7	2.20	1,737	5.1	3,518	7.6	2.0
Total	51,196	100	101,810		1.98	23,160	100	46,398	100	2.0

Table 14 - Contribution of different zones to the imports of some engineering and electrical products in 1975

Products / Zone	Engineering products	Electrical products	Machine tools	Public works machinery	Agricultural machinery	Utility vehicles	Electrical distribution equipment	Television
Market economy countries	50 to 55%							
U.S.A.	6.4	8.7	6.7	4.0	12.6	10.1	2.8	12.7
Japan	1.6	1.5	1.8	1.1	0.7	0.04	0.3	0.3
Western Europe	38.4	45.0	36.4	28.7	34.7	18.9	24.3	51.4
Planned economy countries	14.7	7.7	27.3	10.7	22.0	8.9	16.3	1.4
Developing countries	30 to 35		25 to 30	45 to 50	15 to 20	50 to 55	45 to 50	20 to 25
Africa	7.4	7.1	6.2	12.5	6.1	16.3	11.9	5.0
Middle East	6.9	6.8	3.0	14.0	2.2	20.7	15.7	3.5
Far East (excluding Japan)	7.7	9.0	6.9	10.3	1.9	6.8	11.5	4.7
Latin America	7.7	7.6	10.1	10.0	8.3	8.2	4.1	6.9
Total in US $ millions	101,810	46,398	5,618	7,576.1	3,352	13,398	2,672	2,390

Imports of non-electric machinery (S.I.T.C. 71) by developing countries in 1970 and 1975

Table 15

Countries	POPULATION 1972		IMPORTS							Per capita G.N.P.
			Millions of US $		Rate of variation	Percentages		Per capita		
	Millions	%	1970	1975	1970/75	1970	1975	1970	1975	Dollars
1. Petroleum exporting countries	218.2	12.3	1,669.9	10,297.4	6.16	21.4	35.6	7.6	47.1	906
2. India, Brazil, Argentina, Mexico and South Korea	772.0	43.7	2,132.9	6,091.8	2.85	27.4	21.0	2.8	7.8	365.8
3. Other developing countries grouped according to the per capita G.N.P.										
- more than $500 21 countries	46.6	2.7	779.5	2,886.5	3.70	10.0	10.0	16.7	61.9	780.11
- $250 to $500 20 countries	171.0	9.7	1,343.6	4,487.3	3.34	17.2	15.6	7.8	26.2	358.7
- less than $250 22 countries	494.1	28.0	1,326.9	3,067.2	4.61	17.0	10.6	2.6	6.2	137.0
- other developing countries 45 countries	63.5	3.6	540.4	2,058.9	3.8	7.0	7.2	8.5	32.4	584
TOTAL	1,765.4	100	7,793.2	28,889.1	3.7	100	100	4.4	16.3	280

Imports of non-electric machinery (S.I.T.C. 71) by developing countries in 1970 and 1975

Non-electric machinery - SITC 71

Table 16

Countries	Population 1972		IMPORTS						G.N.P.	Rate of variation of imports 1970 to 1975
			Millions of US $		Percentages		US $ per capita		US $ per capita	
	Millions	%	1970	1975	1970	1975	1970	1975		
1. Petroleum exporting countries	218.2	12.3	1,669.9	10,297.4	21.4	35.6	7.6	47.1	906	6.16
2. India, Brazil, Argentina, Mexico and South Korea	772.0	43.7	2,132.9	6,091.8	27.4	21.0	2.8	7.8	365.8	2.85
3. Other developing countries grouped according to the population										
- Population less than 1 million - 13 countries	5.7	0.3	154.8	367.2	1.9	1.3	27.1	64.4	562.0	2.37
- Population between 1 to 5 millions - 23 countries	63.9	3.7	650.3	2,693.2	8.4	9.4	10.1	42.1	344.0	4.14
- Population between 5 to 10 millions - 12 countries	86.9	4.9	712.6	1,907.6	9.1	6.6	8.2	21.9	354	2.67
- Population between 10 to 30 millions - 13 countries	221.5	12.6	788.2	2,210.6	10.2	7.7	3.5	9.9	174	2.80
- Population between 30 to 50 millions - 7 countries	333.7	18.9	1,144.1	3,262.4	14.7	11.3	3.8	11.0	198.5	2.85
- Other developing countries - 46 countries	63.5	3.6	540.4	2,058.9	6.9	7.1	8.5	32.4	584	3.80
TOTAL	1,765.4	100	7,793.2	28,889.1	100	100	4.4	16.3	280	3.7

Sources: Economic Commission for Europe
Bulletin of statistics on world trade in engineering products, 1970 and 1975,
United Nations

II - THE PROJECTIONS

It is only possible to give some orders of magnitude, established on the basis of very simplifying hypotheses. At the same time the questions which are put forward, and the problems which are raised, will make it possible to orientate subsequent studies.

1. Projections on the basis of the UNCTAD hypotheses

Hypotheses were drawn up by UNCTAD for the Nairobi Conference[1] on the growth of the manufacturing industry in the developing countries in order to achieve the objective fixed at the LIMA Conference. The rates of growth, together with the absolute levels of production and of trading in the year 2000, were calculated for the main sectors in the manufacturing industry, in particular for the engineering and electrical industries sector.

The basic figures are given in Table 17.

- The mean rate of growth retained for the period 1972-2000 for the industrialised countries, and for manufacturing production, was 5.1%. This should be compared with the rate of 5.9% over the period 1960-1972 (5.6% for the market economy developed countries and 9% for the communist countries of Eastern Europe). This mean rate of 5.1% differs with the period: 7.0% over the period 1975-1980, 5.5% over the period 1980-1990 and 4.7% over the period 1990-2000.

  No indication is given on the rates of growth retained for the GDP in the industrialised countries.

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(1) The dimensions of the development in the structures to be applied to world trading and production of manufactured articles to achieve the LIMA objective - CNUCEDDIV - TD/185/Supp. 1 - May 1976.

- In order to achieve the objective fixed at the LIMA Conference (25% of industrial production, in terms of added value, by the year 2000 in the developing countries) the rate of growth of manufacturing production in the developing countries should be 9.6% over the period 1972-2000 (as compared with a rate of 6.6% over the period 1960-1972). This average rate would differ according with the period: 11% over the period 1975-1980, 10.3% over the period 1980-1990, and 9.3% over the period 1990-2000.

These projections imply also that, over the period 1972-2000, manufacturing production in the developing countries would increase by $ 1,300 billion, a figure very similar to manufacturing production in the industrialised countries in 1972 ($ 1060 billion).

Three other hypotheses are advanced in the document for the developing countries:

- Rate of increase in the GDP: 7.5% (5.3% over the period 1960-1972)
- Rate of population increase: 2.1% to 2.5% per year,
- Mean level of investment required: 22% of the GDP (1... : year in the year 1966).

Important note: All the following relates to projections for the whole of the engineering and electrical industries sectors, which includes capital goods, intermediate goods and consumer goods. At this stage it has not been possible to isolate the capital goods.

A - Projection of the demand for engineering and electrical goods (ISIC 38 sector) over the period 1970-2000

The demand, period by period, will depend on the coefficient of investment and hence on the marginal capital coefficient, the composition of gross fixed capital formation (construction, equipment, means of transport), and the techniques used which will result in repercussions on the capital coefficient. This

demand will also differ considerably according to the stage of development reached by the country[1].

An order of magnitude can be calculated for the whole of the engineering and electrical industries sector (including durable consumer goods).

UNCTAD has estimated that, in the case of the developing countries, the domestic demand[2] in the year 2000 would be $ 1020 billion at 1972 prices[3]. This demand has been estimated at $ 58 billion in 1972, divided into $ 40 billion for production and $ 18 billion from net imports.

This leads to a demand increase factor of about 17.5 over 28 years, or a rate of growth of 10.7% per year.

The rate of growth of the demand can also be calculated from a regression equation linking the rate of growth of the per capita demand to the rate of growth of the per capita income[5].

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(1) See on this subject the results for a certain number of countries concerning the contribution of investments in relation to machines and equipment and the expenditure indices in relation to the GFCF and on the basis of machines and equipment in the role of the position of the mechanical industries. EEC, 1974, pp. 34 and 35.

(2) Domestic demand = Production + Imports - Exports

(3) See Table, p. 21 of the UNCTAD document for the Nairobi Conference (op. cit.).

(4) See Table 6, paragraph 2.

(5) UNIDO monograph on industrial development - Engineering Industry (page 12), 1971 - ID/40/4.

$$\log \frac{C}{P} = - 2.665 + 1.564 \log Y/P$$

where $\frac{C}{P}$ represents the per capita demand ($)

and $\frac{Y}{P}$ represents the per capita income ($)

The rate of growth of the per capita GDP being of the order of 5 to 3.4% the rate f growth of per capita demand will vary between 7.8% (1.564 x 5) and 8.4% (1.564 x 5.4), or a rate of growth of the overall demand of the order of 10.5% per year.

The result of this calculation leads to a rate of 10.4%, a result which is very similar to that deduced above.

These rates of growth relate to the whole of the engineering and electrical industries sector: in the case of capital goods the rate of growth in the demand is likely to be greater than this.

Such rates have been observed in Brazil over recent years and also in Mexico; the projections made for the period 1975-1990 show that the demand will develop at rates of 13 to 14%[1].

One may also cite the case of Spain where, over the period 1960-1970, the rate of growth of demand for capital goods in the gross fixed capital formation was 11.8%[2].

B - Projection of production

The gross projections by UNCTAD for the developing countries are as follows:

	Production (added value)		Annual rate of growth over the period
	1972 (US $b)	2000 (US $b)	
Non-electrical machinery	9.6	228	11.9%
Electrical machinery	4.5	99	11.6%
Transport equipment	6.5	120	11.0%
TOTAL	20.6	447	11.5%

Or a multiplication factor of 21.6 over 28 years and 27.0 over 30 years.

(1) The capital goods industry - Mexico, 1977 - NAFINSA - UNIDO.

(2) The rôle and place of the engineering industries - Economic Commission for Europe.

By way of comparison the past trends[1] in the rates of growth in the engineering and electrical industry were as follows:

in Asia 11.0% for the period 1960-1970
11.3% for the period 1970-1974

for Latin America 9.2% for the period 1960-1970
14 % for the period 1970-1974;

in the case of Africa the data are not available.

It should be noted that these high rates are only due to a small number of countries.

The UNCTAD projections make it possible to draw various conclusions:

1) The projections, both of demand and of production, are confirmed by historical observations made in certain developing countries during a period shorter than that envisaged in the projections. A priori, therefore, they do not appear to be impossible, but they assume the generalisation of cases which until now have been exceptional, together with prolonged extrapolation.

2) The degree of covering of consumption by production in the developing countries would be 87%[2]

3) The elasticity of growth of production in the engineering and electrical industries as compared with the growth of production in manufacturing industries generally will be established at 1.2 (11.5%/9.6%).

Examination of the figures in Table 18 shows that the elasticity of 1.2, which has been implicitly retained by UNCTAD, is slightly lower than the mean elasticity observed over the period 1955-1970 for the developing countries (1.35, but with major variations over the period 1960-1970 : 1.68 during 1960-1965 and 1.05 during 1965-1970).

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(1) see Table 5, paragraph 2

(2) Consumption $ 1020 billion, gross production $ 895 billion, (estimated by UNCTAD at double the net production).

4) The contribution of the engineering and electrical industries sector in the developing countries to world production in the year 2000 can therefore be calculated. Calculation of this share depends, in effect, on the rate of growth of the sector in the industrialised countries (in respect of which UNCTAD has not advanced any hypotheses), which in its turn depends on the elasticity of the growth of the engineering and electrical industries sector as compared with growth in the manufacturing industries generally.

Two complementary hypotheses will be introduced:

- an elasticity of 1.1, which corresponds approximately to a continuation of past trends (see Table 18).

- an elasticity of 1.2, corresponding to a movement towards restructuring in the industrialised countries which will develop their equipment industry in the face of the export prospects offered by markets in the developing countries.

These make it possible to deduce the total production in the industrialised countries.

	Value of the production (added value) in the industrialised countries (ISIC class 38)		
	1972 (US $b)	Rate of growth of the MEI over the period	2000 (US $b)
Elasticity 1.1	432.6	5.1 x 1.1 = 5.61% (multiplication factor: 4)	1,730.4
Elasticity 1.2	432.6	5.1 x 1.2 = 6.12% (multiplication factor: 5.3)	2,292.7

With the net production of the developing countries, according to UNCTAD, being evaluated at $ 447 billion in the year 2000, the contribution of the developing countries to the world production of the mechanical and electrical industries in the year 2000 would be:

with an elasticity of 1.1 in the industrialised countries:

$$\frac{447}{447 + 1730} = 20.6\%$$

and with an elasticity of 1.2 would be:

$$\frac{447}{447 + 2292} = 16.3\%$$

C - Projections of imports and exports

Exports from the developing countries

In the year 2000 exports will represent 16% of the production, 40 to 50% of this being sent to other developing countries and 50 to 60% to the developed countries.

The following considerable increase in exports is forecast (account should be taken of the fact that the initial level is low):

- Mechanical machinery: 16% increase per year in exports, or a factor of 85 over 30 years.

- Electrical machinery: 12.4% increase per year in exports, or a factor of 30 over 30 years.

- Transport equipment: 14.5% increase per year in exports, or a factor of 60 over 30 years.

Imports by the developing countries

In the year 2000 imports into the developing countries will represent 28% of the consumption, 25 to 30% coming from other developing countries and 70 to 75% from the developed countries.

The increase in imports is shown by the following figures:

- Mechanical machinery: 9% increase per year in imports, or a factor of 13.5 over 30 years.
- Electrical machinery: 8.95% increase per year in imports, or a factor of 13 over 30 years.
- Transport equipment: 7.7% increase per year in imports or a factor of 9.3 over 30 years.

Net trading with the developed countries

In the year 2000 the developing countries will still be net importers of capital goods, despite major substitutions for imports with the demand 80% satisfied by local production instead of only 40 to 50% in the 1970s.

Net imports from the developed countries will increase by a factor of 7.5 over 30 years, or a rate of increase of 7% per year.

Projections of foreign trading for the developing countries raise two questions:

. the origin and destination of the products by zones,
. the nature of the products involved.

Mutual trading between the developing countries is likely to increase rapidly. In 1973[1] imports from other developing countries represented only 4% of total imports, whereas in the year 2000 they will represent of the order of 25 to 30%.

(1) Table 8, paragraph 2.

By contrast, and both in respect of exports and imports, the UNCTAD document does not make any distinction within the industrialised countries between market economy countries and planned economy countries[1]. At the present time[2] imports from planned economy countries are very low (1% of the total imports), and this poses the question of those changes which may be envisaged by the year 2000.

As far as products exported by the developing countries are concerned these relate mainly to capital goods to other developing countries (as in the case of India and Brazil) or of components and consumer goods to the industrialised countries (Hong Kong, Singapore and Mexico).

This raises the question of the future attitude of the industrialised countries to the importing of capital goods from the developing countries, since it is true that in this case part is carried out through multinational companies.

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(1) In another and older document on trading in manufactured articles from developing countries, 1974 - TD/BC.2/16. A distinction was made which shows the very low participation of the planned economy countries in trading of manufactured products up to the year 2000

(2) Table 8, paragraph 2.

2. Projections based on the UNIDO model

The UNIDO model is a model for the computer simulation of world industry.

It is operational at a level of branches of activity and geographical regions. It simulates, on the basis of coefficients of elasticity observed in the past, what the indices and numerical values (in constant value dollars) of the industries in the developing countries could be under the double constraint of 1) the rate of growth in the economy of the industrialised countries; 2) the realisation of the Lima objective establishing - in general - a contribution of the developing countries to world production by the year 2000 of 25%.

It relates therefore to normative projections. This is a category which must be carefully differentiated from forecasts and scenarios.

The model does not forecast any development. It is [illegible] recording a future conditioned by the two previous hypotheses, to which a third is then added: the relationships observed in the past between growth, demand and production will continue to operate with the same internal coherence and intensity at the level of industrial activities. The model is therefore both normative where the future is concerned (it "tends" towards an aim, linked with different rates of growth) and simulative as to the past (it "reproduces" past relationships, linked to models of consumption and to technological coefficients of conversion).

It does not therefore forecast how rates of growth in the industrial and developing countries will evolve, but what the latter should be in order to realise the Lima objectives on the basis of various hypotheses as to growth in the industrialised countries.

Nor does it forecaat changes in technological progress which are likely to modify the coefficients of conversion, nor possible deviations in the models of consumption in relation to those existing at the present time. For example the model does not introduce as a standard the basic needs for the developing countries. The external trading movements appearing as a balance in the model show the differences between consumption and production by geographical regions. It does not introduce a "wish" to modify the latter, but only the proportions of world industrial production as shared by the developing and industrialised countries.

Since it does not consider the projects and strategies of the actors the model is therefore not a scenario, or more precisely it is one amongst hundreds of conceivable scenarios.

However its interest is that of supplying a general and coherent framework on the basis of which it would be possible, progressively, to incorporate other explicit hypotheses of possible or probable evolutions and normative hypotheses. In this sense the prospective sectorial studies are one of the ways of linking the model to the possibilities and probabilities of future evolution.

Two macro-economic hypotheses have been put forward as to the rate of growth of the GDP (Gross Domestic Product) in the developed countries over the period 1970-2000, these being 4% and 3.6%.

The rate of 4% indicates a slowing down in relation to that observed over the last 25 years. However, and considered from the historical point of view, these rates correspond to a considerable rate of growth: over 30 years it would result in multiplying the GDP of the industrialised countries by 3.25.

The rate of 2.6% would still result in multiplying the latter by 2.17. It appears therefore, a priori, more likely than a rate which, by hypothesis, would prolong the present economic recession in the market economy countries into a structural crisis. Provided

that, considering that these rates cover two different - although partially interdependent - realities, that of the planned economy countries and that of the market economy countries, one therefore introduces another hypothesis: that of the continuation of the progress of the planned economy countries and, as a consequence, the quasi-stagnation of the market economy countries.

The macro-economic magnitudes are set out in Table 19.

It can be seen that, in order to achieve the LIMA objective (25% of manufacturing production), growth in the developing countries should, on the hypothesis of a growth of 4% in the GDP in the developed countries, be a rate of growth in the GDP of 8% and of 9.3% for the rate of growth in manufacturing production (added value).

On the hypothesis of a growth rate of 2.6% in the GDP of the developed countries the figure would be 6.5% for the growth of the GDP and 7.8% for the rate of growth in manufacturing production (added value).

In order to give a picture of the significance of these abstract magnitudes it may be said that, on the hypothesis of the higher rate of growth, the increase in manufacturing production to be achieved in the developing countries between 1970 and the year 2000 would be equal to that of the industrialised countries in 1970. The industrial transfer to be achieved during that historically very short period would therefore be enormous.

On the second hypothesis it still corresponds to 60% of the manufacturing production of the developed countries in 1970.

It has been possible to take into account the three sectors of mechanical machinery, electrical machinery and instruments in the UNIDO model, and this makes it possible to identify rather more closely the category of capital goods.

The results of the projections are summarised in Table 20.

On the hypothesis of a rate of growth of the GDP of 4% in the developed countries the production of capital goods in the developing countries would increase at a rate of 11.2% per year (or an elasticity of 1.4 in relation to the GDP and 1.16 in relation to manufacturing production).

Consumption would increase at a rate of 10.5% per year, or an elasticity of 1.31 as compared with the GDP.

Net imports (exports - imports) would increase at a rate of 9.6% per year.

The consumption of capital goods met by local production would rise from 45% in 1970 to 55% in the year 2000.

On this hypothesis the general Lima objective of 25% would not be achieved for capital goods, but the contribution of the developing countries in the year 2000 would nevertheless represent 16.7% of world production of capital goods as against 2% to 3% in 1970.

In order to form an opinion on this change it should be noted that the production of capital goods in the developing countries in the year 2000 would represent 78% of that of the industrialised countries in 1970, and their consumption would represent 1.5 times that of the latter in 1970. Despite the increase, by local production, in the level of covering of needs net imports would have to be multiplied by 16. In this way an enormous market would be open to the industrialised countries. The net exports of the latter, which represented less than 4% of their production in 1970, would be equivalent to 60% of the 1970 production by the year 2000.

On the hypothesis of a rate of growth in the GDP of 2.6% in the industrialised countries the contribution of capital goods produced by the developing countries would not vary substantially when compared with the hypothesis of the high rate of growth, being 16.9%.

In the same way the degree of cover of consumption by local production would be of the same order, namely 55%.

The production of capital goods by the developing countries would, in the year 2000, represent 52% of that of the industrialised countries in 1970. Their consumption would be equal to that of the latter in 1970. Net imports would be multiplied by more than 10. The net exports of the industrialised countries would still represent 42% of the 1970 production, and the open market would therefore still remain very considerable.

These projections obviously do not indicate that these implicit scenarios are possible nor, a fortiori, probable. The UNIDO model furthermore makes it possible to trace the evolutions between regions. Table 21 gives a breakdown of the production of capital goods between the developing regions.

3. Is the Lima objective of 25% possible when applied to capital goods ?

In the two models used, those of UNCTAD and UNIDO, the objective of 25% (which has never signified 25% for any specific sector) is not achieved in the production of capital goods. This result is not, however, surprising. It nevertheless seemed to be of value to analyse under what conditions this objective could be achieved.

To do this it is necessary to reason in the inverse direction and to deduce the rates of growth of the sector and the necessary elasticity coefficients in relation to manufacturing industry generally.

In 1970 the contribution of the production from the developing countries (ISIC 38) was 3.1% of world production. One may estimate the contribution of capital goods at 2%, since this is surely nearer to reality.

One starts from the UNCTAD hypotheses concerning the rate of growth of manufacturing industry in the industrialised countries of 5.1% and that of the rate of growth of the manufacturing industry in the developing countries of 9.6%.

One also accepts, for the industrialised countries, the two previous hypotheses on the rates of elasticity between the rates of growth of the production of capital goods and the rate of growth of manufacturing production, namely 1.1 and 1.2.

In this way one obtains, (Table 22) the necessary rates of growth in the developing countries to attain 25% of the world production of capital goods for the two elasticity hypotheses.

These rates are respectively 15.5 and 16.5% per year. As compared with the rate of growth of manufacturing production of 9.6% this gives elasticities of:

$$\frac{15.5}{9.6} = 1.61 \quad \text{and} \quad \frac{16.5}{9.6} = 1.72$$

These elasticities can be compared with those found over the period 1955-1970 (Table 18).

- For the planned economy countries the elasticity was 1.30 to 1.39 over the whole of the period 1955-1970. The effort towards industrialisation was therefore extremely high.

- For the developing countries:

  . in Latin America the elasticity was 1.61 over the period 1955-1970, but with a very distinct trend towards a drop (from 2.10 over the period 1955-1960 to 1.30 over the period 1965-1970);

  . in Asia (excluding Israel and Japan) the elasticity was 1.55 over the period 1955-1970 with major variations, including an elasticity of less than 1 during the period 1965-1970 (0.87).

Furthermore these high rates achieved in Latin America and Asia are only due to certain engineering and electrical consumer goods such as cars and household domestic appliances.

These observations indicate that the necessary elasticity value - and hence the accumulation of fixed capital - would be too high having regard to historical experience. They assume a political will and a tension very strongly generalised over the whole of the Third World and permanently maintained, obviously independently of the difficulties of industrial realisation arising from the degree of complexity of capital goods, which are analysed in the following chapters. The hypotheses are therefore theoretically not impossible, but in practice are very improbable and this allows one to conclude with some certainty that it is impossible for the developing countries to reach 25% of the production of capital goods by the year 2000.

The same exercise can obviously be carried out with lower rates of growth, leading to very similar results and the same general conclusion.

4. Projections of employment

Again it can only be a question here of establishing the orders of magnitude of the incidence on employment of building and developing a capital goods industry in the developing countries.

Estimates of employment in the engineering, electrical and transport industries vary according to the sources, and show serious gaps. Data are lacking for a large number of the developing countries; frequently there are no chronological series but only fragmentary indications, and it is not certain that these are homogeneous from one country to another. This is why, instead of an accuracy which could be misleading, we will retain an estimate within a range of 3 to 4 million workers for these industries in the developing countries.

Obviously the level of employment is better known in the industrialised countries, and this was 45 million workers in 1970[1].

In order to make the projections the following hypotheses are assumed:

a) In the year 2000 the value of production in the engineering and electrical industries in the developing countries will be equal to that of the industrialised countries in 1970 (UNCTAD model) or 75% of this (UNIDO model, on a hypothesis of a 4% rate of growth of the GDP in the industrialised countries).

b) In the year 2000 the productivity of the developing countries in these industries would be that of the industrialised countries in 1970, whereas it is half of this at the present time.

(1) unpublished United Nations estimate.

Under these conditions the volume of employment in the industries related to the capital goods category would be 35 to 45 million workers.

The rate of growth in employment should be from 7.5 to 8.5% per year.

These orders of magnitude call for some comments.

- Firstly they show that the capital goods industries could be an important source of employment in the developing countries.

- Next the qualitative aspect of employment in industries which require skilled labour should be emphasised. To train several tens of millions of skilled workers, technicians and engineers on a world scale is not an insoluble task. It is not, however, an easy one.

- Finally this order of magnitude is very flexible as a function of the production choices made. In effect the volumes of employment have been calculated by reference to the mean in the electrical and engineering industries of the industrialised countries; the production of less complex and more widely used capital goods could require more labour than the figures indicated above.

5. Projections in respect of capital investment

From projections of employment we move on to the determination of orders of magnitude of capital investment by means of estimated costs of the creation of employment in the capital goods industry.

The creation of one job in the latter is estimated in Mexico at $ 10,000[1]. These are direct costs.

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(1) Outline of a strategy for the development of the capital goods industry. December 1976, NAFINSA (UNIDO).

In reality one should add, to these those charges which are attributable to the cost of industrial training, the remuneration of foreign personnel, the creation of accompanying organisations such as institutes of technology, standards, information centres, specialised marketing and management, etc. Experience shows that these double the direct costs.

For those countries which have to establish an organisational network the real cost of creating one job is likely to be about $ 30,000.

The direct cost of industrial transfer of the projected capacity for capital goods in the developing countries would therefore be of the order of $ 400 - 500 billion.

The indirect costs depend, amongst other things, on the pre-existence or not of an executive infrastructure, and the latter can be roughly estimated at $ 600 - 900 billion.

In reality no serious estimate can be put forward except after a specific study based on observation of the realities in the developing countries, the projects of the latter and the development prospects for prices of capital goods exported by the industrialised countries. Experience shows that the capital coefficients vary from 1 to 2 and are sometimes even higher between the developing countries, and the prices of imports of capital goods are tending to rise rapidly, frequently exceeding the rate of inflation in the market economy developed countries. It would therefore be necessary to study these problems.

However, irrespective of the corrections to be applied to these broad estimates, one fact still remains: the cost of creating employment in the capital goods industry is relatively lower than in other sectors[1].

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(1) By way of comparison the direct costs amount to $ 100,000 to 200,000 per job created in the iron and steel industry and from $ 100,000 to $ 300,000 in agrobusiness.

III - THE LONG-TERM TECHNOLOGICAL TRENDS

It is only possible here to set out some observations in broad outline on the development of technologies and techniques which could have major repercussions on the development of a capital goods sector in the developing countries.

1. Automation of the production process

One of the characteristics of present developments in industrial equipment is the major use made of electronic measuring, control and checking instrumentation. Such instrumentation is increasingly tending to be integrated into control systems by the use of computers. Automation is, at the same time, a group of methods of analysis of production processes in order to design continuous processes and regulation and control techniques to produce a satisfactorily automated system. The aim of automation is to optimise the production of industrial units, that is to say to reduce their operating costs.

Control of production processes may be installed in various stages :

1 - centralisation of information and remote control
2 - installation of local regulation links,
3 - progressive increases in automatic links between local links,
4 - progressive installation of automatic computer calculating links operating on a basis of permanent information and as a function of pre-established programmes. The results of these calculations are made available to the operator,
5 - finally, automatic control by direct action derived from the results obtained by these calculations. This is the stage of computer operation.

At the present time it is the penultimate phase which is most widely used in the industrialised countries, particularly in the chemical industry. The last stage, which requires total knowledge of all the phenomena and of their interactions, is still comparatively little used.

The combined use of microprocessors for the automation of local production chains with management computers will accelerate the development of integrated management of production units. For example by using a computer and several mini-computers it is possible to integrate the functions of handling and management of a company. In a more general manner automation by the combined use of a computer and micro-computers makes it possible to integrate the management of various systems in a company: production, control, maintenance, sales, financial[1].

Automation is essential in all industrial sectors with continuous processes (iron and steel production, petrochemicals, etc.) but is beginning to be used in batch production processes, particularly in the engineering industry. A team of research workers at the University of Michigan has made a technological forecast for the coming years. They have attempted to predict the rôle of computers in the future production of engineering and electrical products, and their forecasts are as follows[2]:

1) Programming time will be reduced by 25% by 1977.
2) Nearly 25% of breakdowns will be detected and diagnosed by computer by 1978.
3) By 1980 25% of all machines will be computer controlled. The productivity of machine tools will be increased by 25-30%.
4) By 1982 25% of all the mechanical parts of machines will be produced by computer controlled systems.
5) By 1983 25% of machine tools will be integrated into a control system, and the accuracy of the tools will be increased by 50%.
6) By 1988 only 25% of the components manufactured will be controlled directly by human means. One of the results of the development of the information collection and information control networks will be to reduce organisational and management charges by 10 to 20%.

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(1) P. LEBENBAUM, Industrial systems and organisations in Handbook of industrial engineering and management.

(2) From the journal Iron Age, 20/12/1973.

This study carried out by the University of Michigan underlines the increasing dissociation of man and machinery and the rise in skilled work at software level.

"The computer itself finds no difficulty in carrying out its mission. The experts participating in the CIRP study[1] agree in effect in stating that, by 1985, a major part of the knowledge acquired in the field of manufacturing techniques will have been distilled into the software, so as to control all the necessary stages of manufacture. It will select the sequences of machining, it will change parts in a selective manner to the appropriate machine tools, it will control tolerances, it will choose the sequence of operations, it will supply the appropriate tools at the required moment, it will apply the optimum conditions for machining for the material, it will ensure that the required shapes are produced to the required degree of accuracy by digital control, and that management will be kept informed of everything which happens at every point in the system and at every moment".[2]

2. Constant changes in the electronic industry

The whole of the sector is characterised by the very rapid obsolescence of techniques and equipment because of the size of investments devoted to research and development.

The life of semi-conductors, of which considerable use is made in various types of appliances, provides a typical example of this situation: in 25 years there have already been three generations of products, beginning with the discrete components of the beginning of the fifties, passing in the sixties to integrated circuits associating several discrete components before arriving, towards the end of the sixties, at integration on a medium or large scale, combining hundreds of integrated circuits[3].

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(1) International College for the Scientific Study of Mechanical Production Techniques.

(2) R. REDALE. Links with the factory of tomorrow - Publication of the European Committee for Cooperation in the Machine Tool Industries (CECIMO).

(3) Y.S. CHANG. The Transfer of Technology: Economics of Offshore Assembly. The case of the Semi-conductor Industry, UNITAR Research report No. 11 (New York, United Nations, 1971).

The industry has not ceased to perfect and miniaturise components whilst at the same time reducing production costs (including labour costs) by using new materials and automating the manufacturing processes. In this way the multi-purpose mini-computers adopted about five years ago represent the most spectacular progress accomplished in the electronic industry in recent years[1].

3. The growing complexity of machinery

Machines are increasingly specialised, and are also increasingly integrated into a system of machines.

It may be seen that, in production units manufacturing long runs of mass consumption products on a basis of automation, the machines are increasingly specialised in the production of one given product. As standardisation tends to increase in products of widespread consumption so the machine tool which is used to produce them must be of a special and original type. One may extend this observation not only to all the machines which take part in automated long-run production processes, but also to small and medium production runs. Automation multiplies the machines and specialises them... As a result of mechanisation and the automation of new manufacturing processes a need is felt for new installations, diversified and of increasing complexity. The components of machines and the machines themselves, the special and automatic devices which are perfected from day to day, result not only in a rapid increase in the number of appliances but also in increased diversification in the latter and a multiplication of their types and models.

This trend, which tends to see the machine tool industry no longer as involved in the construction of series of isolated machines but in the construction of increasingly integrated systems of machines, can be seen in a study carried out by the Institute of Science and Technology of the University of Michigan on the subject "Progress in the technology of production, Forecasts up to 1985". This study

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[1] Cited in the publication of the O.I.T. Commission of the Mechanical Industries, Geneva, 1977, General report.

concludes that, by 1980, a quarter of all new purchases of machine tools in the United States will involve the purchase of complete manufacturing systems bought from a single supplier. These conclusions echo the forecasts made for the engineering industries by C.I.R.P. (International College for the Scientific Study of Mechanical Production Techniques). "between now and 1990 (on average) more than 50% of the machine tools built will not be used in an autonomous manner, but within the framework of a flexible production system ensuring the automatic manipulation of parts between work stations, and entirely controlled by an industrial computer".

One finds the same trend in other types of machines, as for example in machines for converting plastics materials:

"Originally extruders were produced and delivered as hardware products. The converters designed or bought the dies, reel-off systems and other systems to complete their lines. At the present time the tendency is towards producing and selling complete installations. This trend is shown by an increase in the average cost of machines sold over the last five years. Complete installations include components such as printing units or bag-making units in blow-extruded film installations, and machines to label, engrave and cut in the case of tube or profile extrusion lines. Other companies are specialising in complete installations for the extrusion of profiles and tubing, including the reel-off and reel-up systems".(1)

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(1) Arthur D. LITTLE, Techniques and processes for converting plastics materials in the United States and in the Federal Republic of Germany. Report to the Minister for Industrial and Scientific Development, Paris, July 1973.

Table 17 - UNCTAD PROJECTIONS

	1960	1972	1975	1980	1990	2000	Rate of growth 1960-72	1972-2000	1975-1980	1980-1990	1990-2000
			Millions					Percentages			
Population											
Developing countries											
Possibility A	1,320	1,770	1,915*	2,166	2,641	3,065	2.5	2.5	2.5	2.0	1.5
Possibility B					2,772	3,550				2.5	2.5
Market economy developed countries	680	773	799*	837	925	1,021	1.1	1.0	1.0	1.0	1.0
Eastern European communist countries	312	356	367*	385	426	470	1.0	1.0	1.0	1.0	1.0
Total	2,312	2,907	3,081	3,388	3,992	4,556	1.8	1.6	1.9	1.7	1.3
					4,123	5,041		2.0		2.0	2.0
Manufacturing production		Billions of dollars (1972)						Percentages			
Developing countries	50	108	130	219	500	1,411	6.6	9.6	11.0	10.3	9.3
Market economy developed countries	420	810	810	1,580	2,685	4 233	5.6	5.1	7.0	5.4	4.7
Eastern European communist countries	88	248	317				9.0				
Total	558	1,166	1,257	1,799	3,265	5,644	6.3	5.8	7.4	6.1	5.6
Breakdown of manufacturing production			Percentages								
Developing countries	9.0	9.3	10.3	12.2	17.8	25.0					
Market economy developed countries	75.2	69.4	64.4	87.8	82.2	75.0					
Eastern European communist countries	15.8	21.3	25.3								
Total	100.0	100.0	100.0	100.0	100.0	100.0					
Per capita production			1972 Dollars								
Developing countries	38	61	68	101	220	460					
Market economy developed countries	618	1,048	1,014	1,293	209	398					
Eastern European communist countries	283	696	864		1,987	2,859					
Total	242	401	408	531	818	1,239					
					792	1,120					

Sources: UNCTAD IV Nairobi - TD/185/Supp. 1, 12 April 1976.

Relationship between the rates of increase of production in the metallurgical, engineering and electrical industries, and overall industrial production, 1955-1970

Table 18

Source: The rôle and place of the mechanical industries

Regions	1955-1960	1960-1965	1965-1970	1955-1970
World a)				
of which:	1.17	1.23	1.19	1.21
Planned economy countries b)	1.30	1.39	1.33	1.34
Market economy countries	1.07	1.13	1.07	1.09
of which:				
Market economy developed countries c)	1.02	1.20	1.07	1.10
Market economy developing countries d)	1.38	1.68	1.05	1.35
North America e)	0.91	1.19	0.76	1.00
Caribbean, Central and South America	2.10	1.38	1.30	1.61
Asia f)	2.05	1.55	1.69	1.78
Asia f), excluding Israel and Japan	1.63	2.06	0.87	1.55
Europe - market economy developed countries	1.07	1.04	1.05	1.05
European Economic Community	1.19	1.06	1.05	1.12
European Free Trade Association	1.00	1.10	1.12	1.05
Oceania g)	1.40	1.21	0.77	1.13

Relationships between the rates of increase of production in the metallurgical, engineering and electrical industries and those of the gross domestic product (A) and overall industrial production (B) in certain countries, 1960-1970

Countries	A			B		
	1960-1965	1965-1970	1960-1970	1960-1965	1965-1970	1960-1970
Bulgaria	2.68	1.79	2.18	1.55	1.46	1.50
Czechoslovakia	3.55	1.40	1.84	1.23	1.42	1.34
German Democratic Rep.	2.38	1.38	1.79	1.42	1.13	1.26
Hungary	2.02	1.21	1.52	1.19	1.55	1.35
Poland	2.37	2.02	2.18	1.67	1.46	1.56
Romania	1.87	2.08	1.97	1.24	1.29	1.27
USSR	1.88	1.53	1.69	1.43	1.38	1.41
Belgium	1.34	1.24	1.37	1.39	1.12	1.26
France	0.91	1.12	1.02	1.17	0.98	1.07
Federal Rep. of Germany	1.10	1.35	1.23	1.06	1.27	1.16
Italy	1.04	1.42	1.21	1.05	1.23	1.14
Holland	1.02	1.38	1.19	0.86	0.88	0.86
Austria	0.70	1.59	1.17	0.64	1.31	1.00
Denmark	1.19	1.00	1.10	0.97	...	...
Finland	1.19	1.28	1.23	0.81	0.97	0.90
Norway	1.13	1.09	1.10	1.03	1.04	1.04
Portugal	1.19	2.15	1.66	0.90	1.72	1.30
Sweden	1.78	1.81	1.79	1.19	1.23	1.21
Switzerland	0.92	...	...	0.87	1.05	0.96
United Kingdom	1.17	1.04	1.07	1.09	1.09	1.07
Spain	2.17	1.95	2.08	1.57	1.23	1.42
Yugoslavia	1.60	...	...	1.04	0.90	0.99
Canada	2.02	1.18	1.63	1.51	1.13	1.36
United States	1.53	0.81	1.26	1.18	0.74	1.02
Japan	1.48	1.97	1.75	1.27	1.45	1.39

Table 19 - UNIDO Model

EVOLUTION OF THE MACRO-ECONOMIC MAGNITUDES

Hypothesis 1

	Developed countries			Developing countries		
	1970 (US$b)	Annual rate of increase as %	2000 (US$b)	1970 (US$b)	Annual rate of increase as %	2000 (US$b)
Gross domestic product (GDP)	2,723.09	4.0	8,831.77	363.01	8.0	3,690.64
Manufacturing output	1,465.86	4.3	5,247.64	96.58	9.6	1,531.12
Manufacturing (added value)	586.35	3.9	1,835.83	42.38	9.3	612.21

Hypothesis 2

	1970 (US$b)	Annual rate of increase as %	2000 (US$b)	1970 (US$b)	Annual rate of increase as %	2000 (US$b)
Gross domestic product (GDP)	2,723.09	2.6	5,934.00	363.01	6.5	2,420.42
Manufacturing output	1,465.86	2.9	3,499.83	96.58	8.2	1,020.87
Manufacturing (added value)	586.35	2.5	1,224.83	42.38	7.8	408.32

Table 20 - DEVELOPMENT OF PRODUCTION, NET EXPORTS AND REQUIREMENTS FOR MECHANICAL MACHINERY, ELECTRICAL MACHINERY AND INSTRUMENTATION

Hypothesis 1: Rate of growth of the GDP in the developed countries of 4%

	Developed countries				Developing countries			
	1970 (US$b)	2000 (US$b)	Factor of increase	Annual rate of growth	1970 (US$b)	2000 (US$b)	Factor of increase	Annual rate of growth
Production (output)	274.70	1,068.07	3.88	4.6	8.80	215.40	24.5	11.2
Net exports	10.60	168.31	16	9.6	- 10.80	- 173.34	16	9.6
Consumption (requirements)	264.10	899.76	3.40	4.2	19.60	388.74	19.8	10.5

Hypothesis 2: Rate of growth of the GDP in the developed countries of 2.6%

	Developed countries				Developing countries			
	1970 (US$b)	2000 (US$b)	Factor of increase	Annual rate of growth	1970 (US$b)	2000 (US$b)	Factor of increase	Annual rate of growth
Production (output)	274.70	712.71	2.59	3.2	8.80	144.86	16.4	9.8
Net exports	10.60	111.6	10.5	8.2	- 10.80	- 118.36	10.5	8.2
Consumption (requirements)	264.10	601.11	2.27	2.8	19.60	+ 263.22	13.40	9.0

Table 21 - **BREAKDOWN OF PRODUCTION IN THE YEAR 2000 FOR MECHANICAL MACHINERY, ELECTRICAL MACHINERY AND INSTRUMENTATION BETWEEN THE FOUR MAIN DEVELOPING REGIONS**

	Latin America		East and South-East Asia		Middle East petroleum producing countries		Africa and Middle East (not petroleum producing)		TOTAL	
	1970	2000	1970	2000	1970	2000	1970	2000	1970	2000
Hypothesis 1 Rate of growth of the GDP in the developed countries of 4%	59.0	58.9	28.4	22.5	0	12.8	12.6	5.8	100	100
Hypothesis 2 Rate of growth of the GDP in the developed countries of 2.6%	59.0	58.9	28.4	17.7	0	17.6	12.6	5.8	100	100

Table 22 - **REQUIRED RATE OF GROWTH OF THE CAPITAL GOODS INDUSTRY IN THE DEVELOPING COUNTRIES TO ACHIEVE THE LIMA OBJECTIVE**

	1st hypothesis: elasticity 1.1					2nd hypothesis: elasticity 1.2				
		1970 → 2000		2000			1970 → 2000		2000	
	1970	Rate of increase	factor		%	1970	Rate of increase	factor		%
Market economy developed countries + communist countries	98	5.61%	4.45	436	75	98	6.12%	5.9	578	75
Developing countries	2	15.50%	72.50	145	25	2	16.50%	96	192	25
TOTAL	100			580	100	100			770	100

IV - CONCLUSIONS

1. The New Economic Order to be constructed can not be based on a prolongation of the existing international division of labour.

One of the essential characteristics of the latter is that 97% to 98% of the production of capital goods takes place in the industrialised countries. One of the keys to the development of the Third World is to ensure its production of part of its needs for investment in fixed capital. This production is necessary for the following reasons :

a) Without a capital goods industry the developing countries, if they realise the rates of growth corresponding to the Lima objectives, cannot escape from dependence. The latter will in fact be accentuated by industrialisation. The industrial fabric of the developing countries will depend exclusively on the industrial and technological centres of the industrialised countries. Internal integration of industries, and even sub-regional integration, would be almost impossible.

The problem is therefore a political one. It does not relate to interdependence but to its weak or strong modalities.

b) The very logic of the Lima Declaration means that the objectives which have been fixed will result in a large increase in manufacturing production and a sudden break with the rates observed in the past. As a consequence there will ensue a demand for capital goods which will be proportionately even greater. This will have to be satisfied by imports and by local production. Unless the latter is increased the effect on the trading balances of the developing countries will be to produce deficits which will undoubtedly be insoluble.

c) The establishment and development of capital goods industries adapted to the needs and possibilities of the various developing countries will contribute substantially to their fights against unemployment.

d) Since it is a skilled labour industry the development of this sector could reduce the inequalities in the field of the qualification of workers which at present exists between the industrialised and developing countries.

e) By its direct action and the indirect measures needed for its environment the capital goods industry creates the conditions for the developing countries to control a wide range of technologies and in this way opens up the possibilities for true assimilation of transferred technologies and, subsequently, for the creation of local capabilities for innovation.

2. It is clear that the 25% objective of the Lima Declaration excludes the capital goods sector.

However the UNCTAD and UNIDO models show that, by the year 2000, a proportion of capital goods produced in the developing countries of the order of 15% - subject to verification of the possibility of realising this - would be coherent with the overall objective.

3. These models also suggest that, irrespective of the hypotheses, the industrialisation of the Third World will constitute an enormous outlet for the capital goods industries of the industrialised countries, and an essential factor in advancing their economies. According to the hypotheses taken into consideration in the UNIDO model the net exports of capital goods from the industrialised countries to the developing countries would be equivalent, in the year 2000, to from 40% to 60% of their production in 1970 (as against 4% at the present time). This would result in a major modification in the structure of international commerce.

4. The magnitude of the changes to be implemented implies the pursuance of reflection and study in this field.

Prospective reflection implies the following approach :

a) It will be necessary to break down the capital goods sector into sub-systems which are significant from the point of view of the development policies. This is why Chapter II provides an initial answer.

b) It is necessary to consider the development of capital goods from the specific standpoints of, firstly, the typological grouping of products and, secondly, the typological grouping of countries. Chapters II and III provide a first sketch of such an analysis.

c) It is necessary to identify on the one hand the projects and strategies of the industrialised countries and, on the other, those of the developing countries. It is necessary to ascertain the complementarity or intersections of the projects and the compatibilities and incompatibilities of the strateg

The actors must be clearly identified. The aggregates of the "industrialised countries" and of the "Third World" are both abstractions. The real industrial world consists of communist countries and developed capitalist countries. Within the latter the expansionist strategies of the capital goods industries of the United States, of Japan and of West Germany, to take only a few examples, must be reviewed. In the same way it is necessary to consider in order the expansion projects of developing countries such as Brazil, Mexico, India and China which already have a capital goods industry, those countries which have an embryonic industry and those which propose to establish one.

d) It will be necessary, in a second stage, to consider international trading not as a simple matter of balances but as the sum of explicit projects, derived from the strategies of the international partners.

e) It is necessary to consider technical coefficients as variables and not as invariants. They are subject to developments in technological progress, but also to choices in industrial production.

The capital coefficients are possibly not linear but are discontinuous as a function of development thresholds. It is necessary to increase knowledge in this field and where necessary to draw the implications for various groups of developing countries.

f) It is necessary to improve the statistical apparatus so as, for example, to make 1980 an improved reference year.

This improved information on the structures of the world capital goods industry and on the projects of the actors will then make it possible, using the framework of the existing simulation models and that of UNIDO in particular, to incorporate new explicit hypotheses in the models and, by means of enquiries from experts, to measure their probabilities. In this way one can pass from projections to prospective studies. The way is in this way opened up to the establishment of scenarios where the normative scenario would be compared with the possible scenarios and the latter with the probable scenario.

The stages of the consultation may therefore be set out as follows :

1. An appreciation of the existing situation and of the principle of the need for the developing countries to create or to reinforce a capital goods industry.

This appreciation of the situation implies the identification of the projects or intentions of the actors.

2. The selection of a reference scenario corresponding firstly to the Lima objectives and secondly to the respective possibilities of the partners, the constraints specific to the sector and the probabilities of realisation.

3. Determination of the ways and means for realising the specific objectives of the reference scenario which has been adopted.

These ways and means will concern : the development scenario, the possible and desirable trajectories and itineraries, the international cooperation programme to be put into effect and the administrative consequences for the United Nations system.

CHAPTER II

STRUCTURES OF THE CAPITAL GOODS INDUSTRY

INTRODUCTION

An analysis of the structure of the capital goods industry needs to be made so that it may be used for action, irrespective of the level of development of the countries involved.

The three components of this structure are:

1) The internal arrangement of capital goods products, their division into groups having common characters. To these intrinsic characteristics it is convenient to add the extrinsic characteristics of the internal capital goods system, that is to say the national and international environment.

2) The final demand. Capital goods are not produced for themselves, but for a final demand. It is therefore necessary to analyse the typological correspondence between the latter and the various groups of products. Any strategy of modifying the final demand (for example the basic needs) would have repercussions on the capital goods.

3) Countries produce or do not produce capital goods. This disparity is one of the essential characteristics of under-development. Within the developing countries some possess such an industry, others have only an embryonic industry. Their potentialities vary, particularly as a function of their basic development and size. Starting from a typology setting capital goods products against final demand (which expresses the aims or the projects of civilisation of the countries) one hopes: a) to determine the entry possibilities of the developing countries by groups of products; b) to define the conditions of access from one level to another.

Such a three-dimensional typology is only initiated in this paper. The present chapter relates to a two-dimensional typology of products and final demand. Chapter III consists of a typology of countries from the point of view of the capital goods industry.

1 - AN ESSAY IN CLASSIFICATION

1.1. Delimitation of the sector

1.1.1. Economic considerations

a) It will be recalled that the term capital goods denotes the sector producing those goods which contribute to gross fixed capital formation in:

- agriculture,
- industry,
- services,
- administration.

b) This sector is only part of the metal converting sector, which is still termed the engineering and electrical industries, since this sector produces:

- capital goods,
- intermediate goods,
- durable consumer goods.

In the developed countries the production of the engineering and electrical engineering industries can be broken down, as a function of final demand, in the following manner:

- durable consumer goods: 15 to 30%,
- intermediate goods: 25 to 40%
- capital goods: 40 to 50%

c) Durable consumer goods (private cars, domestic electrical appliances, radio, television, etc.) do not therefore form part of the sector covered by this study. As far as the intermediate goods are concerned there is some ambiguity since inter-deliveries are considerable, part being consumed by the capital goods sector and part by the durable consumer goods sector.

For this reason, and in view of the importance of these inter-deliveries, it is proposed that the intermediate goods sector should form part of the study except for:

- electronic components, which are above all consumed by the consumer goods sector and which are already the subject of considerable international sub-contracting, and hence "inflate" results in the electrical manufacturing sub-sector for certain countries.

- certain simple metal products such as screws and bolts.

1.1.2. Statistical considerations

In order to be able to monitor production and trading in the sector as defined above and at a world level, and in particular in the developing countries, it is necessary to depend on an international nomenclature.

The UNO nomenclature in respect of production (CITI) is not sufficiently detailed to provide clear definitions, whereas the nomenclature in respect of trading (CTCI) is sufficiently detailed.

a) Production. In this we have used the international classification by industry type for all branches of economic activities (CITI) (International Standard Industrial Classification of All Economic Activities (ISIC))[1].

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[1] Statistical papers - Series M - no. 4, Rev. 2, Add. 1 - United Nations 1971. Sales no. E/71/XVII-3.

The capital goods sector forms part:

- of division 38: Manufacture of fabricated metal products, machinery and equipment

of which the principal groups are:

381 : Manufacture of fabricated metal products, except machinery and equipment
382 : Manufacture of machinery, except electrical
383 : Manufacture of electrical machinery, apparatus, appliances and supplies
384 : Manufacture of transport equipment
385 : Manufacture of professional and scientific measuring and controlling equipment, and photographic and optical goods.

It is proposed to include as capital goods:

1) In principal group 381:

- Part of group 3811: hand and edge tools such as axes and hatchets, chisels and files, hammers, shovels, rakes, hoes and other hand agricultural and garden tools, handsaws and plumbers', masons', mechanics' and machinists' precision hand-tools.

- Group 3813 - Manufacture of structural metal products.

2) In principal group 382: manufacture of machinery except electrical.

- The whole of this group.

An ambiguity exists in group 3825 inasfar as, apart from computers, it includes many products which it is difficult to regard as capital goods (typewriters, small calculating machines, etc.).

3) In principal group 383 (Manufacture of electrical machinery, apparatus, appliances and supplies).

- Group 3831 (Manufacture of electrical industrial machinery and apparatus).

- Part of group 3832 - Wire and wireless telephone and telegraph equipment, radio and television transmitting, signalling and detection equipment and apparatus, radar equipment and installations.

- Part of group 3839 - Wire and cables, snap switches, conductor connectors and other current-carrying wiring devices.

4) In principal group 384 (Manufacture of transport equipment)

- Group 3841 (Shipbuilding and repairing),
- Group 3842 (Manufacture of railroad equipment),
- Group 3843 (Manufacture of motor vehicles) except private cars.
- Group 3845 (Manufacture of aircraft).

5) In principal group 385 (Manufacture of professional and scientific measuring and controlling equipment, and photographic and optical goods).

- Group 3851 (Manufacture of professional and scientific measuring and controlling equipment).

b) Trading

There are two nomenclatures: one dating from 1961[1] and a more recent one dating from 1975[2].

1961 Nomenclature All the data on international trading are transcribed under this nomenclature up to the present day.

Division 69

Only the following groups:

691 - Finished structural parts.
692 - Metal containers for storage and transport.
695 - Tools for use in the hand or in machines.

Section 7

Division 71

The whole of this division except:

714.1 - Typewriters and cheque-writing machines.
719.4 - Domestic appliances, non-electrical.

Division 72

The whole of this division except:

724.1 - Television
724.2 - Radio
729.1 - Batteries and accumulators
729.2 - Electric lamps
729.3 - Valves, tubes, transistors, etc.
729.4 - Automotive electrical equipment for vehicles

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(1) Standard International Trade Classification Revised - Statistical Papers - Series M no. 34 - 1961.

(2) Standard International Trade Classification Revision 2 - Statistical Papers - Series M no. 34 - Rev. 2.

Division 73

The whole of the division except:

732.1 - Passenger motor cars

732.9 - Motorcycles, motorised cycles

733 - Road vehicles other than motor vehicles

Division 86

Only the following sub-groups represent capital goods:

861.3 - Binoculars, microscopes

861.7 - Medical instruments

861.8 - Meters and counters, non-electric

861.9 - Measuring, controlling and scientific instruments n.e.s.

1975 Nomenclature

Division 69

Only the following groups:

691 - Structures and parts of structures.

692 - Metal containers.

695 - Tools for use in the hand or in machines.

Section 7

The following represent capital goods:

Division 71 - Power generating machinery and equipment.
The whole of the division.

Division 72 - Machinery specialised for particular industries.
The whole of the division.

Division 73 - Metalworking machinery.
The whole of the division.

Division 74 - General industrial machinery. The whole of the division.

Division 75 - Office machines and automatic data processing equipment:

only 752: Automatic data processing machines.

Division 76 - Telecommunications and sound recording:

only 764: Telecommunications equipment.

Division 77 - Electrical machinery:

only 771: Electric power machinery,
772: Electrical apparatus for making and breaking electrical circuits,
773: Equipment for distributing electricity,
774: Electric apparatus for medical purposes and radiological apparatus.

Division 78 - Road vehicles:

only 782: Motor vehicles for the transport of goods or materials
783: Road motor vehicles
786: Trailers and other vehicles.

Division 79 - Other transport equipment. The whole of the division.

Division 87 - Professional, scientific and controlling instruments. The whole of the division.

1.2. An essay in classification for the purposes of action

Various classifications have been proposed as a function either of the manufacturing processes and the products[1], or according to whether it involves custom-made or standardised capital goods[2], or as a function of various criteria such as classification by process, by type of goods, by weight of goods, by capital intensity, according to scale, according to sub-contracting potential, according to skills, or according to level of technology[3].

The proposed classification integrates to a large extent all the suggestions already made and meets the following requirements:

1) To establish a clear correspondence between various classes of capital goods and the final demand sectors. This correspondence is necessary in order to be able to establish forecasts of demand in value and in volume.

2) To take into account one of the major characteristics of this sector which is the numerous linkages which exist between products and the technical manufacturing processes. One may

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(1) Summary of conclusions of the Preparatory Expert Panel Meeting for Consultations on the Capital Goods Industry - Vienna, 16-18 May. 1977.

(2) Outline of a strategy for the development of the Capital Goods Industry - Nacional Financiera FINSA/UNIDO - Second Preparatory Expert Panel Meeting for Consultations on the Capital Goods Industry - Vienna, 17-21 November 1977.

(3) Established capital goods industries in developing countries - Richard L. KITCHEN. Second Preparatory Expert Panel Meeting for Consultations on the Capital Goods Industry - Vienna, 17-21 November, 1977.

associate various products (analogue grouping of products) which can be manufactured with the same manufacturing processes, or conversely a technical manufacturing process (forging, casting, machining, etc.) making it possible to manufacture parts or sub-assemblies to be integrated into the various final products.

Important note: Everything which follows concerns only those capital goods which are fabricated metal products, mechanical machinery and electrical machinery. Products relating to the electronic industry will be dealt with subsequently.

1.2.1. An initial classification: custom-made and standardised equipment, related to final demand sectors and to the technological production routes.

THE CONCEPT OF TECHNOLOGICAL PRODUCTION ROUTE

In a general way[1] one may designate under the term technological production route the entirety of production operations:

- associating products (materials, components, sub-assemblies) and processes or basic facilities (casting, forging, metal forming, machining, heat treatment, assembly, etc.) with a view to producing the final product (the whole).

It is also necessary to take into account matters dealing with the operations of:

- design (engineering design capabilities)

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(1) See on this subject the works of the Bureau d'Informations et de Prévisions Economiques (BIPE), France. The main trends in technical progress in the engineering industries 1972-1973, and the two papers presented to the Second Preparatory Expert Panel Meeting for Consultation on the Capital Goods Industry, Vienna, 17-21 November 1977: Development of a heavy capital goods industry in a country in the process of industrialisation: the case of Algeria. COURLET, GAULE, TIBERGHIEN - Université des Sciences Sociales de Grenoble, France: and Establishing capital goods industries in developing countries, Richard L. KITCHEN, op. cit.

- organisation of production and marketing (industrial engineering and marketing).

Any analysis of technical progress in capital goods must therefore be carried out over the whole of the route, that is to say:

- the materials,
- the manufacturing processes,
- the products (final product, sub-assembly, components),
- the design (for example digital or automatic design).

The objective, initially, being to obtain a classification of value for action, it appeared to be advisable to retain only the following three principal factors in the definition of the technological production route:

- design (engineering design capabilities),
- technical manufacturing processes,
- management of production and marketing (industrial engineering and marketing or, according to another terminology, managerial and professional engineering).

All these three factors are determinant in the installation of a capital goods industry. The inputs concerning the materials relate essentially to the links which may or may not exist in any country between the iron and steel and metallurgical industries and the equipment goods industry, and as far as the inputs of the component and sub-assembly types are concerned these are very important in this sector and need to be the subject of separate studies with a view to increasing the level of national integration.

A) Custom-made capital goods

These are normally heavy capital goods, manufactured in units or in very short production runs, and which incorporate a high degree of technicity; their production time is long.

Design (Engineering design capabilities)

One must emphasise the importance of the general contractor who carries out the whole of the installation and who determines the technical specifications for the most important items of equipment. However the equipment manufacturer, who works in close collaboration with the engineering consultant[1], should master the study and design of this equipment (engineering design of machines: design and drawings).

Technical manufacturing processes

Starting from sheet, plate and profiles these processes are essentially:

- cutting: sawing and shearing,
- forming: folding, bending and rolling,
- welding.

In certain cases account must also be taken of heat treatment.

Production management and marketing

In the case of custom-made equipment there is no clear division between design, manufacture and marketing. All there three stages are often coordinated by the engineering consultant. In particular

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[1] Frequently the equipment manufacturer integrates this engineering function.

the importance of quality control in manufacture should be noted, since the equipment has a high technical content, together with the not unimportant amount of erection work on site, the coordination of which often presents difficult problems.

The final demand sectors

Heavy custom-made capital goods are mainly supplied to the following branches:

ISIC 220 - Crude petroleum and natural gas
ISIC 210-230-290 - Mining
ISIC 341 (Part) - Pulp and paper
ISIC 351 - Industrial chemicals
ISIC 3511 - Manufacture of basic industrial chemicals, except fertilizers
ISIC 3512 - Manufacture of fertilizers and pesticides
ISIC 3513 - Manufacture of synthetic resins, plastics materials and man-made fibres, except glass
ISIC 352 - Manufacture of other chemical products
ISIC 353 - Petroleum refineries
ISIC 354 - Manufacture of miscellaneous products from petroleum and coal
ISIC 362 - Manufacture of glass and glass products
ISIC 369 - Manufacture of other non-metallic mineral products (clay products, cement, lime and plaster)
ISIC 371 - Iron and steel basic industries
ISIC 372 - Non-ferrous metal basic industries
ISIC 410 - Electricity, gas and steam
ISIC 7111 - Railway transport

B) Standardised equipment (standardised capital goods)

This covers, in general, light and medium equipment which involves a greater or lesser degree of standardisation, and which is produced in small or medium production runs.

Design (engineering design capabilities)

In the case of the equipment manufacturer the important rôle played by the engineering design of machines should be noted, since the models which are manufactured are fairly diversified, but use common assemblies and sub-assemblies (machines built on a modular basis).

Technical manufacturing processes

Starting from metals in the form of plates or from castings or forgings the processes are essentially machining, heat treatment and assembly which in the case of certain products (buses, tractors and trucks) can be very considerable.

Production and marketing management

Production management is of primary importance since the inputs in the form of parts and sub-assemblies are very numerous, and a high degree of organisation is essential in the assembly operations.

Marketing management is also important because of the importance of after-sales service, in particular the management of stocks of spares.

The final demand sectors

The equipment has been classified on the basis of two final demand criteria.

a) Equipment used in certain industrial branches

- Equipment for agriculture and fishing (ISIC 111-112-130).
- Equipment for transport (ISIC - 7112, 7113, 7114).
- Equipment for the building industry (ISIC 500).
- Equipment for the engineering industry (ISIC 38).
- Equipment for the consumer goods industries.

ISIC 31 - Manufacture of food, beverages and tobacco.
ISIC 32 - Textiles, wearing apparel and leather industries.
ISIC 33 - Manufacture of wood and wood products.
ISIC 342 - Printing, publishing and allied industries.
ISIC 355 - Manufacture of rubber products.
ISIC 356 - Manufacture of plastics products.
ISIC 340 - Other manufacturing industries.

b) General equipment used in all branches

This covers the following equipment:

- Equipment for the distribution of electricity.
- Pumps, valves, compressors, fans.
- Lifting and handling equipment.
- Miscellaneous equipment of the boiler and structural works type.
- Spares and maintenance parts for industrial units.

The whole of this section is summarised in the following table.

Cross-analysis of technological routes and tne final demand for capital goods

Route A Custom-made capital goods			Route B Standardised capital goods	
A. Characteristics of the technological routes				
Engineering design capabilities	Management of production and marketing	Manufacturing processes	Management of production and marketing	Engineering design capabilities
- General contractor - Engineering design of machines	Quality control Installation work on site	Basic metal industry Forgings and castings Machining and assembly Cutting forming welding	- Organisation of inputs and assembly - Sales department (management of spares)	- Engineering design of machines (machines built on a modular basis)

B. Final demand sectors corresponding to the technological routes

1) Basic or intermediate industries

ISIC - 220 - Petroleum
210-230-290 - Mining
341 (Part) - Paper

3511, 3522, 3513, 352, 353, 354 } 35 Chemical industry

362, 369 } Mineral products

371, 372 } Basic metal industry

410 Electricity

7111 Railway transport

2) Equipment used by certain branches

ISIC - 31 Food, beverages and tobacco
32 Textile, leather industries
33 Wood products
342 Printing, publishing
355 Rubber products
356 Plastics products
390 Other manufacturing industries

ISIC 111, 112, 130 Agriculture and fishing

ISIC 7112-3-4 Transport

500 Construction

38 Metal working industry

3) Equipment used by all branches

Summarising, therefore, this first classification shows:

1) Two major technological production routes.

2) A possible classification of equipment goods into three major groups with the corresponding routes[1]:

a) Equipment for basic industries: Route A (Custom-made capital goods)

b) Equipment used by certain branches, or specific equipment:

c) Equipment used in all branches

} Route B (Standardised capital goods)

(1) Equipment involved in electronics manufacture will be dealt with subsequently.

3) From the point of view of manufacturing processes two major routes may be seen:

Route A

- Based on the working of sheets and profiles by cutting, forming and welding.

Route B

- Based on working metal plate with the operations of forging, casting, machining, heat treatment and assembly.

4) Such a classification (highly aggregated) is not yet very operational but it does, however, make it possible to identify the major trends.

For example:

a) Over the period 1960-1971[1] the average annual growth rates of manufacturing outputs by sector in selected developing countries was as follows:

	Mainly consumer non-durables	Mainly intermediate goods	Mainly basic metal industries and metalworking industries
Africa	6.1	8.1	8.6
Asia	7.1	9.5	8.9
Latin America	6.8	9.2	9.4

(1) Industrial development survey - Special issue for the Second General Conference of UNIDO - ID/Conf. 3/2.

The structure of the industry has therefore evolved in favour of the intermediate industries and the engineering industries for which the rate of growth has been greater, and this leads one to believe that the demand for custom-made equipment (Route A) and for machine tools (part of Route B) has been relatively greater than the demand for equipment covered by route B.

b) A development strategy as adopted by a country is shown by investments in the various branches of the economy. At this stage of planning it is already possible to make a breakdown of equipment between the two main routes[1].

However it is necessary to initiate a second stage and to go into further detail, particularly because a working tool of this type can be useful for those countries which wish to enter into the manufacture of capital goods.

1.2.2. An essay in a more operational classification: sub-routes and analogue grouping of products

The previous classification led to three major groups of products and two major basic technological routes. In what follows it is a question of dividing up these three major groups and the routes in such a way as to show more clearly the conditions of entry and/or development of a capital goods industry.

An entry strategy proceeds by way of the installation of "mixed products - basic technological routes" (basic facilities), the complexity of which must be gradually mastered: this leads to taking into account a criterion of complexity in establishing these sub-routes. Furthermore it appears logical to take into

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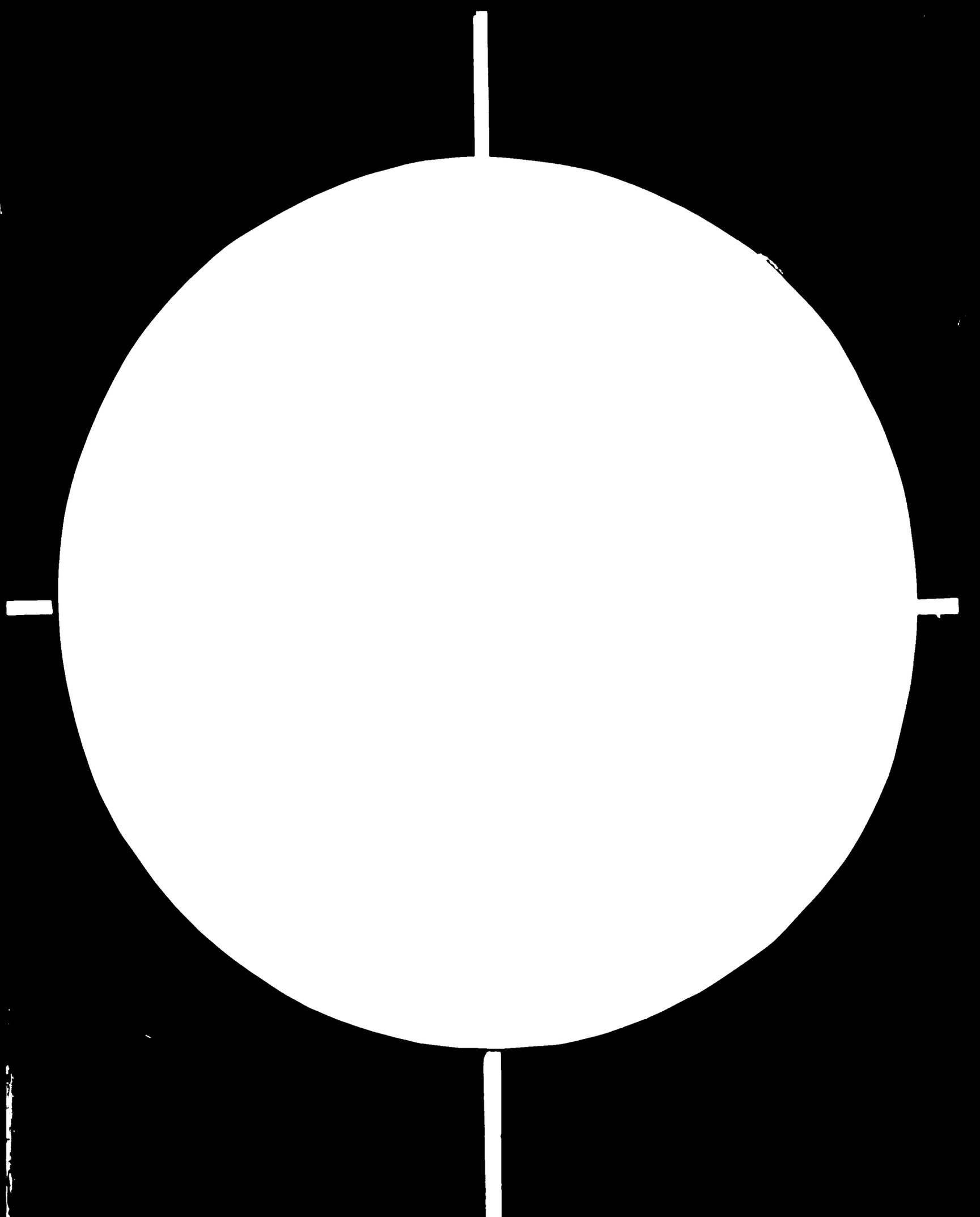
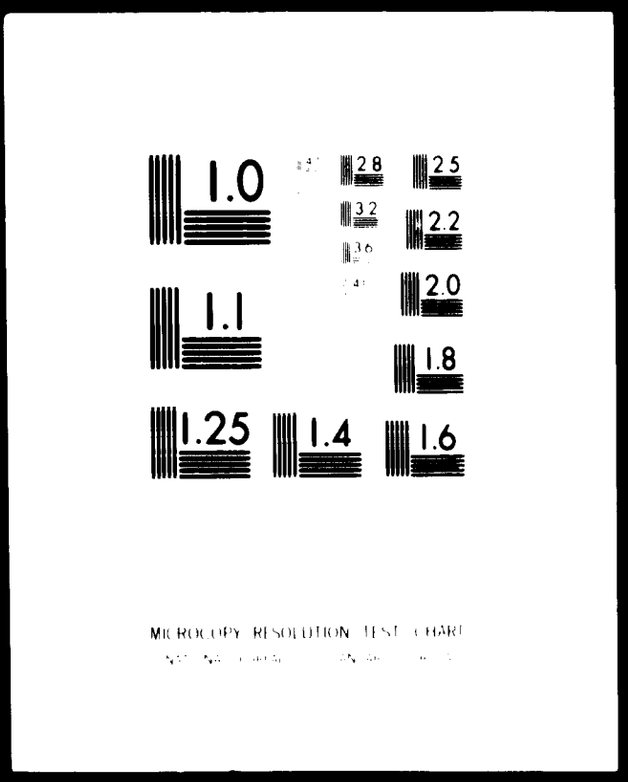
(1) In the case of Algeria, and in the light of the national options concerning the basic industries and, in particular, the valorisation of petroleum and gas, route A represents 35 to 45% of the demand for capital goods and route B 55 to 65% of the demand for capital goods.

C-665

78.11.06





account a dimensional criterion relating to the size and hence the weight of the equipment.

The size of the production unit is not such an important criterion as might sometimes be imagined, since in the capital goods industry the size of the establishment linked with the problems of minimum production runs has fairly little effect, the more so since it is possible to profit from the multi-purpose nature of a manufacturing process or a group of manufacturing processes in order to carry out profitability studies on several products at the same time (grouping of products by their analogous nature) rather than product by product. Furthermore it must be stated that, with the exception of certain industries (tractors, trucks, etc.), the size of the production establishments in the developed countries is often nearer to 300 to 500 employees than 1,000 to 1,500 employees.

In this same order of ideas the criterion of classification by capital intensity is not initially important since firstly, and in a general manner, the capital goods industry with the exception of certain very special sectors is not a capitalist industry and secondly, and particularly for those countries which enter the capital goods industry, the initial production elements are not of high cost.

Criterion of complexity

This criterion is for the moment only used from a qualitative standpoint. The criterion of complexity applies to the three essential elements which we have taken into account in the definition of the technological production group, that is to say:

- design,
- the technical production processes,
- the management of production and marketing.

Three scales of complexity have been used: simple, complex and highly complex.

As an example this means[1]:

- In the case of design: simple - work by designer up to the planner,
  complex - engine[illegible] work on sub-assemblies,
  highly complex - [illegible]f a general contractor
  design of a new
  ma[illegible], including R & D.

- In the case of the technical manufacturing processes:

  From casting of routine parts to precision pressure casting.

- In the case of production and marketing management:

  - From the management of a small production workshop to the management of a factory producing tractors where assembly activities are very considerable,
  - From the simple act of selling to the management of a stock of spares.

Dimensional criterion, or criterion of weight of goods

This criterion is also related to power when it is a question of machines for the generation of power or the use of electrical energy (motors, transformers, switches, hydraulic turbines, thermal turbines, alternators). This criterion is important inasfar as it provides an initial idea on production workshops. One can, in practice, regard the workshops as light, medium or heavy, so making it possible to classify the same product differently: the equipment involved in the production of an electric motor is not the same when small, large or medium-sized motors are being produced; the same applies to compressors or

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(1) It is clearly understood that subsequent studies will have to specify this criterion of complexity and to carry out systematic studies on scales of complexity.

diesel engines (engines for trucks as against large marine engines) or again in the case of metal structures for small buildings or the metal structures which go with heavy process equipment in the petrochemical industry.

In this way, and in relation to the two principal routes, there are introduced two criteria which make it possible to establish the sub-routes.

- Criterion of complexity: simple, complex, highly complex.
- Criterion of weight : light, medium, heavy, which can be regrouped (since the separation is never a clear one) into light and medium or medium and heavy.

This gives six sub-routes for each principal route, or a total of twelve. In fact practice shows that these criteria may be initially combined in the following way[1]:

1 - Light, medium and simple
2 - Light, medium and complex
3 - Medium, heavy and complex
4 - Medium, heavy and highly complex

This gives eight sub-routes: A1 - A2 - A3 - A4
B1 - B2 - B3 - B4

Starting from these eight sub-routes one can then carry out analogue grouping of the products (which is not exhaustive) as set out in the appended table which indicates the correspondences between final demand, analogue grouping of products into eleven classes, and the eight production sub-routes.

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[1] This simplification eliminates two sub-routes (light, medium, highly complex and medium, heavy, simple) which are not regarded as essential in this first stage of the analysis.

From this first table (which may be progressively made more complex) it is possible to draw the following conclusions:

1) Although custom-made equipment largely corresponds to route A and standardised equipment to route B it can be seen that certain products involve both routes A and B.

2) Reading across the lines, that is to say in terms of final demand, shows the differences between the various types of equipment.

- Custom-made equipment, intended for the basic industries, is more of the medium and heavy type, complex or highly complex. This means that:

1) From the point of the manufacturing processes the boiler working shops and structural working shops will be equipped with very large machine tools. Large forging and casting capacities, together with heat treatment facilities, will also be essential.

The existing units in India (Heavy Machine Building Plant, Foundry Forge Plant and Heavy Machine Tools Plant[1]), in Pakistan (State Heavy Engineering and Machine Tool Corporation) and in Iran[2] correspond to this type of route;

2) From the point of view of design (engineering design capabilities) design capabilities (engineering design of machines) and engineering facilities (general contractor) are essential for mastering the production of this type of equipment.

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(1) Heavy Engineering Corporation. Backbone of India's Industry - Scvadera. ID/WG.146/96 - 26 July 1973. Third Interregional Symposium of the Iron and Steel Industry - Brazil, 14-21 October 1973.

(2) The capital goods industry in Iran - Evolution problems and prospects - G.L. Narasimhan - UNIDO expert.

Classification of products as a function of final demand and production sub-routes

Final demand	Analogue grouping of products (Revised CTCI nomenclature)	Route A (cutting, forming, welding)				Route B (casting, forging, heat treatment, machining, assembling)			
		Light & medium		Medium & heavy		Light & medium		Medium & heavy	
		simple A1	complex A2	complex A3	highly complex A4	simple B1	complex B2	complex B3	highly complex B4
A. Custom-built equipment 1 - Medium and heavy equipment for the basic industries	Metal structural work (691), storage tanks (392), boilers, heat exchangers (711-1/711-2), furnaces (719-13). Machinery for cement (719-14, 719-19), machinery for glass (718-52), machinery for the petroleum, petrochemicals and chemicals industries (719-19), rolling mills and converting furnaces (715-21, 715-22), large gantries (719-3), electric furnaces (729-92), machines for foundry work (715-21).			X	X				
	Gas and steam turbines, hydraulic turbines (711-3, 711-6, 711-81), large thermal engines (711-5), large pumps (719-22), alternators (722-1), large compressors (719-22), railroad equipment (719-66), reducers (719-61), large valves (719-92).				X				X
	Transformers, isolator [illegible]hes, circuit breakers for high and [illegible]gh tension (722-2).			X	X			X	X

Classification of products as a function of final demand and production sub-routes (continuation

Final demand	Analogue grouping of products (Revised CTCI nomenclature)	Route A (cutting, forming, welding)				Route B (casting, forging, heat treatment, machining, assembling)			
		Light & medium		Medium & heavy		Light & medium		Medium & heavy	
		simple A1	complex A2	complex A3	highly complex A4	simple B1	complex B2	complex B3	highly complex B4
B. Standardised equipment	Small equipment and tools for agriculture and the building industry (695-1).	X				X			
2 - Equipment used by certain branches	More complex equipment for the building industry and agriculture: concrete mixers, dumpers, preparation of aggregates (718-51), machines for preparing and cultivating the soil (712-1/712-2). Building site cranes (719-3).		X				X		
	Trucks, buses (732-2 to 732-8), tractors (712-5), agricultural machinery (712-2, 712-9), public works and building equipment (718-4).						X	X	
	Machine tools (715-1). Machinery for the agriculture and food industries (712-3), machines for the textile industry (717-1), machines for the leather industry (717-2), printing machinery (718-2), for paper and board machinery (718-11 and 12).							X	X

Classification of products as a function of final demand and production sub-routes (continuation)

Final demand	Analogue grouping of products (Revised CTCI nomenclature)	Route A (cutting, forming, welding)				Route B (casting, forging, heat treatment, machining, assembling)			
		Light & medium		Medium & heavy		Light & medium		Medium & heavy	
		simple A1	complex A2	complex A3	highly complex A4	simple B1	complex B2	complex B3	highly complex B4
3 - Equipment used by all branches	Pumps (719-21), valves (719-92), compressors (719-22), thermal engines (711-5), centrifuges (719-23), electric motors (722-1).						X		
	Lifting and handling equipment (719-3), air conditioning equipment (719-12), gas and liquid filters and separators (719-23), heat exchangers, others.		X				X		
	Tanks, vessels, building structures, boiler works for all branches.	X	X						
	Manufacture of spares and maintenance parts.					X	X		

- Standardised equipment

In the equipment used by certain branches all the sub-routes B1, B2, B3 and B4 are represented; in particular machines for the production of consumer goods are either complex or highly complex.

In the equipment used by all the branches there are no products, taken overall, which are located at the top of the scale of complexity and weight.

3) Reading down the columns, that is to say on the basis of the production sub-routes, shows the predominance of sub-route B2 (casting, forging, heat treatment, mechanical machining, light and medium complex assembly). Mastery of this route is an important factor in the diversified production of capital goods. However, since many products are concerned in this sub-route (as is also the case with other sub-routes), one sees here the justification for analogue grouping of products.

4) Analogue grouping of products based on similar production technology routes has, as its objective, to suggest that it is possible for capital investment decisions to be taken not product by product but by groups of products, and this changes fairly radically the viewpoint from which feasibility studies are generally carried out and poses the profitability of an investment in different terms.

5) From the point of view of final demand it is possible to consider the table from the angle of complexity.

From the viewpoint of production technology route the concept of complexity relates more to the complexity of sub-routes than to the complexity of a product, which means in general that the developing countries should firstly manufacture simple metal products so that they can then manufacture increasingly complex products. The central question for the developing countries involves mastering

all the elements of a route, that is to say the manufacturing processes, design and the management of production and marketing, each stage in the mastery of a sub-group then making it possible to produce a group of capital goods.

THE CASE OF THE ELECTRONICS INDUSTRY(1)

Capital goods relating to the electronics industry can be classified into two principal groups:

- electronic equipment used by the public authorities for civil and military uses such as radar, guidance systems and special telecommunications equipment,

- electronics equipment used by industry and collective services, including computers, telecommunications equipment, control, monitoring and measuring equipment and medical and surgical equipment.

The technological production route is very specific, inasfar as fundamental research and development research are priority and practically unique factors.

At the manufacturing stage one finds mainly cabling and erection.

Finally the phase of quality control, tests and trials is also very important.

2 - THE NATIONAL ENVIRONMENT AND THE PRODUCTION OF CAPITAL GOODS

The question which is posed is one of knowing which accompanying activities are necessary for the establishment of a capital goods industry. We are listing some which appear to us to be the most important (subject to more detailed analyses), and these are to be subsequently examined in greater depth, whilst drawing all the consequences at both the institutional and practical levels.

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(1) These are only quite preliminary observations, the subject being treated in a second phase of this study.

2.1. The necessity for an engineering consultancy structure

Those accompanying activities involving the mastery of technologies, innovation and engineering consultancy may be regarded as essential. These points will be developed in chapter III.

2.2. The necessity for an industrial fabric

In the industrialised countries sub-contracting is very widely developed. One therefore finds the larger companies relying on numerous small and medium-sized companies to supply parts, sub-assemblies or specific services such as heat treatment or rectification. This group of small and medium-sized companies constitutes an essential environment for the development of the capital goods industry, and also forms a complex network of inter-industrial relationships.

It can be seen that this environment scarcely exists in the developing countries[1], and that it is difficult to create[2], so that one must ask the question if sub-contracting is to be conceived only in those industries which have achieved a certain level of industrial development. Specific monographs will need to be produced for the various countries as a function of their stage of development.

2.3. The need for skilled personnel

The capital goods industry is one which uses a great deal of labour, but this is skilled labour at all the various stages of design, manufacture, management and marketing. This problem must be posed in terms of the "critical mass" which is essential before entering any given production route. In this sense future studies must be carried out as a function of the production route, so as to determine the "critical mass" together with the modes of training.

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(1) At least as far as it concerns those countries practising international sub-contracting, but such sub-contracting generally results in disarticulation of the national industrial system.

(2) See the UNIDO publication - Sub-contracting and modernisation of the economy - F.7411.B.12.

2.4. The existence or absence of upstream iron and steel or metallurgical industries

The capital goods industry uses a very wide range of iron and steel and metallurgical inputs with a massive usage of steel and non-ferrous alloys.

Certain countries, such as Bulgaria, have developed a major capital goods industry although their iron and steel industry was neither strongly developed nor diversified.

It would appear, therefore, that for those small and medium-sized countries which are in the first stage of development, and which cannot have from the start or will not have an iron and steel or metallurgical base, the absence of this industry is not an obstacle to the development of a capital goods industry.

The problem is in fact located at another level, that of the diversity of standards and grades of steel which are offered by the industrialised countries and which result in building up large stocks.

It seems therefore that it is necessary to pursue work in two directions:

1) Iron and steel liaison: metallurgy, forging, casting (ferrous and non-ferrous) and capital goods as a function of the size of the countries, their levels of development and possible existing technologies.

2) A study of standards and grades which are principally used in the capital goods industries, so as to make it possible to specify more accurately the international environment in this field.

2.5. The existence of institutions for economic development and programming

Capital goods are closely linked with economic development inasfar as they contribute to the development of agriculture, industry and infrastructures. A coherent economic development programme is therefore essential to make as detailed as possible an analysis of the repercussions (in terms of markets and products) of this development on the capital goods industry.

Furthermore the capital goods sector is, without any doubt, the most difficult sector to programme. In practice this programming relates to:

- the nature of the products to be manufactured, taking into account economic and social reality, the objectives to be established either of a nationally integrated industrial fabric or, on the contrary, production sectors linked organically to trading flows and external production centres,

- the technological production routes to be established, taking into account those connections which exist between products and manufacturing processes,

- the organisation of the production apparatus which can be highly centralised or, on the contrary, highly decentralised,

- the organisation of the system of marketing and of after-sales services, particularly in respect of the agricultural equilibrium, where the demand is very decentralised,

- the organisation of study and design departments,

- the forecasting and organisation of the apparatus for training labour.

This sector, which is central in accumulation, must not be the subject of random programming but of true planning.

3 - THE INTERNATIONAL ENVIRONMENT

Only the following points will be dealt with:

- International establishments,

- The system of control which links the larger countries and the major firms.

3.1. International establishments

No precise studies exist on the establishment of multinational firms in the developing countries and in the capital goods sector. Analysis of some examples appears to show a double movement:

- in those countries where the markets are large (Brazil, Mexico, Argentina, Iran and South Korea), and where there already exists an industrial base, the multinational firms make major investments in the manufacture of finished products;

- in those countries where the cost of labour is lower the investments relate to activities with a high assembly factor (electronic components, electrical and electronic durable consumer goods).

One may give as an example the figures published by the International Labour Organisation on the manufacture of electronic components.

Foreign manufacture of electronic components by companies in the industrialised countries: comparison of the total estimated labour force in 1971 and in 1974 in certain developing countries

Country	Number of workers	
	1971	1974
Singapore	7,750	24,000
Republic of Korea	5,300	23,000
Malaysia	-	18,000
Hong Kong	5,000	9,000
Mexico	3,500	...
Indonesia	350	2,600
Philippines	-	2,000
Thailand	-	2,000
El Salvador	-	1,800

- = nil or negligible ... = not available

Source: UNCTAD. International sub-contracting agreements in the field of electronics between market economy developed countries and developing countries. Cited in Commission des Industries Mécaniques - 10th Session, Geneva 1977. General Report - International Labour Organisation.
ISBN-92-2-201653-X.

3.2. The system of control established by the larger countries and the major firms

3.2.1. Strongly dominant positions in respect of certain products

For example:

- In the field of data processing the USA dominates a considerable part of the world market.

- In the field of machine tools the share of the Federal Republic of Germany in world exports is from 35 to 40%.

- In the field of large electrical equipment the sector is highly concentrated, with only a few suppliers in the major industrialised countries (cf. table on p. II-33).

- In the field of agricultural machinery (including tractors) there are only a dozen firms of world importance (excluding the planned economy countries).

3.2.2. Control by technologies

It is clearly unnecessary to emphasise this point which is so evident. The major firms are increasingly persuaded that "if with credits one can bind for a time, with technology one binds for a longer time, the more so when the technology exported corresponds to a developed technology or one which appears to be so, inasfar as it brings with it an uninterrupted series of developments and transformations". One may even ask if we have not arrived at the stage of "planned technological obsolescence" by having permanently available, behind the technique offered and sold, a new technique to link up with the first[1].

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(1) See on this subject the French MOCI journal reporting the statements of an American professor to a seminar held in Zurich (No. 178, 23/2/1976).

Suppliers of large electrical equipment in the market economy developed countries

	Turbo-alternators	Power transformers	H.T. circuit breakers
FRANCE	. Rateau Schneider . Alsthom Atlantique . CEM (BBC)	. Jeumont Schneider . Alsthom Savoisienne . CEM (BBC)	. Merlin Gerin . Delle Alsthom . CEM (BBC)
BELGIUM		. ACEC (Westinghouse)	
WEST GERMANY	. Brown Boveri . Kraftwerk Union . M.A.N.	. Brown Boveri . Trafo Union	. Brown Boveri . Siemens
ITALY	. Franco Tosi . Marelli . Ansaldo . TIBB (BBC) . Breda	. Legnano . Marelli . ASGEN . Brown Boveri . Breda . Savigliano	. Galileo . Magrini . ADDA
SWEDEN	. Steil LAVAL (ASEA)	. ASEA	. ASEA
SWITZERLAND	. BBC	. BBC	. BBC . Sprecher & Schuh
GREAT BRITAIN	. Reyrolle Parsons . G.E.C.	. Reyrolle Parsons . G.E.C. . Ferranti . Hawker Siddeley	. Reyrolle Parsons . G.E.C.
JAPAN	. Hitachi . Toshiba . Mitsubishi	. Hitachi . Toshiba . Mitsui . Fuji	. Hitachi . Sumitomo . Mitsubishi
USA	. G.E. . Westinghouse	. G.E. . Westinghouse . Allis Chalmers . McGraw Edison	. G.E. . Westinghouse . Allis Chalmers

3.2.3. Control by standards

The deployment of industries at a world scale in a move towards the internationalisation of production and the multiplication of trading has not been possible without an effort towards the standardisation of products at a world level. "Standardisation has been one of the vectors of world expansion of trading by imposing unification at a planetary scale .... One should not under-estimate, furthermore, its contribution to socialisation, the fundamental trend of our epoch, born from the use of the same equipment or the same objects by an increasing number of individuals"(1). The International Standards Association (ISA) created in 1926 grouped together 22 national standards committees. Since 1947 all work on international standards (in all fields other than electronics, which has been controlled since 1904 by the Commission Electronique Internationale : CEI) is now controlled by the International Standards Organisation which succeeded the ISA after the Second World War.

Whilst recognising the essential nature of standards, and the positive role played by international organisations, it is clear that their work in constructing systems of international standards is not sheltered from dominant enterprises or self-protection on the part of States or multinational firms. Since the onset of industrialisation standards have constituted instruments in the strategies drawn up by the larger countries and the major firms in the service of their objectives of domination or self-protection.

The systems of standards make it possible to reinforce a policy of domination. In those advanced industries such as petroleum, petrochemicals, nuclear energy and electronics in which one country, the USA, has a leading position, it can be seen that this country has imposed its system of standards on a large part of the international markets.

Systems of standards are also a means of self-protection of the equipment industries. In the event that certain productions are threatened by external competition countries can adopt more severe standards than the international standards so as to create a new form of customs barrier.

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(1) Louis Armand, President of AFNOR (Association Français de Normalisation)

3.2.4. Control by engineering consultancy

Engineering consultancy is a privileged means which a country has to sell patents and "know-how". Furthermore it is through the realisation of turnkey contracts that engineering consultancy can play the role of spearhead in the export of equipment goods. Furthermore financing is very often linked to this, frequently preventing any participation by the developing countries in the national supply of equipment.

4 - CONCLUSIONS

1. Capital goods are likely to include about 3 million products. This complex world is not, however, unclassifiable. The aim of classification is to understand the arrangement of a system in order to act on it. The typology which is proposed is therefore directed essentially towards action.

2. The two-dimensional analysis of products against final demand which has been initiated is still rudimentary, and must be made more precise. It is open to external progress and is conceived as a process of increasing information.

3. Classification as a function of the final demand suggests that it is necessary to examine the implications of a policy of basic needs on the corresponding necessary structure of the capital goods industry in the countries concerned, and that it is possible to carry out this analysis by starting from the approach used.

4. Classification as a function of technological routes suggests that it should be possible - and necessary - to approach decisions on capital investments and studies of feasibility from a new angle. Profitability will no longer be appreciated at the level of one product or one isolated operation, but of groups of analogous products.

5. The existence of groups of capital goods common to all branches of the final demand suggests a concrete strategy for the progressive entry of certain developing countries into the capital goods industry.

The identification of product analogies and key technologies opens the way to a precise strategy of progressive assimilation of technologies and to an active policy of internal technological transfers.

6. It is therefore not utopian, in the long term, and if this work is continued, to establish scales of action taking into account the complexity of technological routes, the conditions of national and international environment which are associated with them, the analogies between products, and their repetitive character. This will make it possible for developing countries to make conscious choices on the basis of their development objectives and their natural potentialities. In particular it will make it possible to integrate technology into them, not as an external datum but as a variable to be mastered.

CHAPTER III

A STRATEGY FOR ENTRY INTO AND/OR THE DEVELOPMENT OF A CAPITAL GOODS INDUSTRY FOR THE DEVELOPING COUNTRIES

1. A NATIONAL POLICY OF CAPITAL GOODS AND A TYPOLOGY OF THE DEVELOPING COUNTRIES

In the previous chapter a two-dimensional typology of products or capital goods against final demand was established. It is now necessary to describe the third dimension of this, namely a typology of the developing countries.

1.1. A typology of the developing countries

The first criterion to be considered is the size (absolute and relative) of the capital goods industry in the countries[1], so making it possible to classify the countries into three groups:

- Countries which have a diversified capital goods industry: 5 countries
- Countries which have reached a certain level: 18 countries
- Countries which have, as yet, effectively no capital goods industry: 96 countries

The two first groups, or 23 countries, are listed in Table 1; all the countries considered have work forces in class 38 of more than 10% as compared with the whole manufacturing industry. This classification is somewhat arbitrary and could be revised as a function of more recent data.

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(1) The importance (absolute) is measured by the number of employees in class 382 (CITI): products of engineering construction, this class containing practically exclusively capital goods; whereas the relative importance is measured by the proportion of workers in class 38 (CITI) as compared with the whole manufacturing industry. Figures are taken from the Yearbook of Industrial Statistics - 1974 Edition, Volume I. These are figures for the year 1970, the reason for which we have added Algeria, Tunisia and Morocco.

Table 1

LIST OF THE 5 DEVELOPING COUNTRIES WHICH HAVE A DIVERSIFIED CAPITAL GOODS INDUSTRY AND THE 18 COUNTRIES AND ONE TERRITORY WHICH HAVE REACHED A CERTAIN LEVEL

COUNTRY	Workers in class 382 (thousands)	Workers in class 38 (thousands)	Workers in class 38 as a percentage of workers in all manufacturing industries
India	296	829	17.3
Brazil	153	518	23.8
Argentine	90	336	n.a.
South Korea	39	128	15.5
Mexico	23	67	n.a.
Pakistan	16	65	15.5
Egypt	14	83	13.7
Singapore	14	43	35.4
Philippines	13.3	49	12.6
Chile	12.8	52	21.2
Colombia	12.5	53	15.8
Puerto Rico	10.7	23	16.7
Turkey	9	125.8	22.7
Peru	9	35.4	15.6
Hong Kong	7.4	121.5	22.1
Malaysia	7.1	23.9	15.6
Iran	6.9	105.8	19.9
Venezuela	5.1	30.3	14.4
Thailand	4.4	18.4	9.4
Sri Lanka	2.4	19.0	19.7
Nigeria	1.6	15.6	12.1
Algeria	n.a.	n.a.	n.a.
Morocco	n.a.	n.a.	n.a.
Tunisia	n.a.	n.a.	n.a.

These 19 and the other 114 countries and territories were then classified[1] according to size and the per capita GNP (1970 values), showing the petroleum producing countries and those countries considered by UNO as being the least developed (29 countries).

It can be seen that, of the 96 countries (Table 2):

- 34 countries and 18 territories have fewer than 1 million inhabitants. These are generally insular countries in which the per capita GNP is rather of the order of $ 500 or above than $ 250 or below. There are only 5 of the least developed countries (in the UNO sense).

- 50 countries have between 1 and 10 million inhabitants. Many of these are African countries in the arid zones and without a coastline, and this explains the presence of 17 less developed countries. The per capita GNP is generally of the order of $ 250 to $ 500.

- 12 countries have 10 million inhabitants or more. This group includes 8 of the least developed countries, and all of them have a GNP of less than $ 250 per inhabitant.

(1) See the appended list of countries.

Table 2

CLASSIFICATION OF 118 COUNTRIES (HAVING PRACTICALLY NO CAPITAL GOODS INDUSTRY) AS A FUNCTION OF SIZE AND PER CAPITA GNP

Population in thousands / Per capita GNP	50 to 300	300 to 500	500 to 1000	1000 to 5000	5000 to 10000	10000 to 30000	30000 to 50000	more than 50000	TOTAL
More than $ 500	17 of which ppc = 4	5 of which ppc = 5	4 of which ppc = 3	6 of which ppc = 2	2 of which ppc = 1	-	-	-	34
$ 250 to $ 500	14	2	2	14	6	-	-	-	38
Less than $ 250	8 of which ldc = 4	2 of which ldc = 1	2 of which ldc = 1	14 of which ldc = 12	8 of which ldc = 5	9 of which ldc = 5	1 of which ldc = 1	2 of which ldc = 2 ppc = 1	46
	39	9	8	34	16	9	1	2	118

ppc: petroleum producing countries

ldc: least developed countries

Source: World Bank Atlas

Table 3

CLASSIFICATION OF THE 19 COUNTRIES WHICH HAVE REACHED A CERTAIN LEVEL OF CAPITAL GOODS PRODUCTION AS A FUNCTION OF SIZE AND GNP

Population in thousands / Per capita GNP	1000 to 5000	5000 to 10000	10000 to 30000	30000 to 50000	more than 50000	TOTAL
More than $ 500	3	1	2			6
$ 250 to $ 500	1		4 of which ppc = 2	2 of which ppc = 1		7
Less than $ 250			1	3 of which ppc = 1	2	6
	4	1	7	5	2	19

ppc = petroleum producing countries

Source: World Bank Atlas

In the case of the 19 countries having a certain basic production of capital goods we therefore have the following situation:

- 6 have between 1 and 10 million inhabitants
- 13 have more than 10 million inhabitants

1.2. Potentialities and strategies of entry and/or development as a function of the typology of the countries

1.2.1. The case of the 118 countries where there is no capital goods industry

It is suggested that a start be made from the final demand, from the concept of basic needs. These are:

- to be fed
- to be housed
- to be clothed and shod
- to be educated
- to be cared for
- to communicate

.. To be fed relates to agriculture and fishing where it is possible to distinguish livestock agriculture, agriculture for an industrial end (cotton, flax, hemp, tobacco, ground nuts, coffee, cocoa, etc.) and agriculture for export ends, whether of livestock or for industrial purposes;

.. To be housed, educated and to be cared for relates to building in the form of dwellings, schools, health centres and equipment for dwellings;

.. to be clothed and shod relate to the consumer goods industries;

.. to communicate relates to the transport industry in all its forms and also to the telecommunications industry.

Taken overall therefore it is a question of starting from these basic needs and exploring all possible industrial activities and all the ways thereby opened, and to check wherever possible to see what constitutes the pivot of an industrialisation enterprise, namely the engineering, mechanical, electrical and electronic industries. These industries correspond to the exercise of the mechanical capacity of man at grips with nature in order to modify it.

Hence on the basis of the final demand, expressed in terms of basic needs, one arrives essentially at:

- Agriculture,
- Building,
- Consumer goods,
- Transport.

the development of which induces an extremely diverse demand for capital goods (simple agricultural tools, irrigation pumps, mechanical maintenance of transport vehicles, electronic maintenance of health centre equipment, etc.).

In order to illustrate this method we will limit ourselves to the following brief examples:

Agriculture, fishing and capital goods[1]

The table set out in the previous chapter shows that "entry" into the manufacture of capital goods necessitates the mastery of four sub-routes, two (simple and complex) relating to the working of sheets and profiles (cutting, forming and welding) and two (simple and complex) relating to forging, casting, heat treatment and machining.

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(1) This point will be more particularly developed in another study being carried out by UNIDA (ICIS) relating to the "Strategy for agricultural mechanisation and development of the agricultural machinery industry".

Building and capital goods

In this field considerable work needs to be carried out to list the various building techniques and the various possible materials which can be used according to the country, since the building materials industry, which does not only cover cement, results in a demand for capital goods (manufacture of concrete blocks, bricks, tiles). The technological production routes are more or less the same as for agriculture.

Consumer goods and capital goods

The machines for the production of consumer goods (textile machinery, machines for production of clothing and footwear) call on complex to highly complex routes (according to the techniques in operation in the western countries). Failing research into the appropriate technologies the possibilities of entry into this route are fairly low.

Transport and capital goods

The size of the market has a very considerable influence on this type of capital goods. Assembly industries can be envisaged initially, but the fundamental problem of maintenance and the manufacture of certain spares, which call on the mechanical machining route, then arises.

What, therefore, are the possibilities, according to the countries ?

The case of the small countries

These number 38 with 18 territories and have less than 1 million inhabitants. Most of them are in an insular situation with a relatively high per capita GNP.

Diversification of the capital goods industry does not appear to be possible, and the priorities are based on the installation of some basic technological routes which can meet the requirements of agriculture, building and maintenance.

Medium-sized countries (between 1 and 10 million inhabitants)

These number 50 (34 of which have between 1 and 5 million inhabitants), and it is perhaps in respect of these countries that the problems are the most complex, since the markets are so limited. As an example Denmark, which has 5 million inhabitants, has 150,000 workers in the engineering industry. However this country has opted for international specialisation which is not possible for countries which are just starting in the capital goods industry unless, like Hong Kong, (4 million inhabitants, 120,000 workers in the engineering industry), they can establish an industry directed towards exports.

The installation of the basic routes in the direction of agriculture and building remain essential. However it is necessary to explore these possibilities in several directions:

1) Is any complementarity between neighbouring countries possible (as in the case of the countries of Africa and Central America, for example) ?

2) What analogue grouping of products is possible, particularly in regard to equipment goods used in all branches ?

3) Do possibilities exist for a fairly diversified converting industry, in particular of consumer goods, which will allow the manufacture of some simple capital goods ?

4) What basic industries could exist in these countries (cement, mini-iron and steel industry, electrification) ? These various industries induce a demand for capital goods relating to route A.

5) What possibilities are there for a machine tools industry ?

The larger countries (more than 10 million inhabitants)[1]

These number 12, but have a very low per capita GNP, 8 being considered by UNO as being the least advanced.[2] This has a negative effect in respect of the size of the market which, a priori, would appear to be sufficient.

There does not appear to be any general recipe here. The problem needs to be looked at case by case so as to analyse, very concretely, the possible strategies for agriculture and industry with a view to satisfying basic needs, and with a view to exporting, since these countries have more need than others of currency in order to be able to import.

1.2.2. The case of the 19 countries which have an embryonic capital goods industry

In the case of these countries it is a question of pursuing the development which has already been started and which is shown by a high proportion of products covered by class 381 (CITI), that is to say simple metal products.

The approach on the basis of basic needs remains valid, and can be made concrete by the installation of production routes and/or units, the more so when the size of the countries permits some diversification.

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(1) By way of comparison: Spain has 34 million inhabitants and 550,000 workers in the engineering industry, Hungary 10 million inhabitants and 550,000 workers, whereas Zaïre with 19 million inhabitants has 5,000 workers and Bangladesh with 72 million inhabitants has 12,000 workers.

(2) Which presents a problem of financing.

These countries must therefore master the simple production technology routes. A possible objective for them would therefore be to move to a higher level in the fields:

- of design,
- of manufacturing techniques,
- of management and marketing.

It is therefore necessary, as a function of the specific choices in the final demand and of the sub-groups of capital goods which are capable of being produced, to specify the levels of complexity and the corresponding problems so as to establish, progressively, an engineering structure which is capable of surmounting them.

In conclusion: it is suggested that the analysis of action should not be concentrated solely on the five countries in the Third World which have already "taken off" in respect of a capital goods industry. These have their specific problems, but they are of another nature.

List of the 18 countries and 1 territory in the initial stages of a capital goods industry

Country	Population (thousands)	Per capita GNP ($)	Country	Population (thousands)	Per capita GNP ($)
1m to 5m inhabitants			30m to 50m inhabitants		
Hong Kong	4249	1610	Turkey	39167	750
Singapore	2219	2240	Thailand	40780	310
Puerto Rico	3030	2230	Egypt	36350	280
			Iran (ppc)	33100	1250
5m to 10m inhabitants			Philippines	41433	330
Tunisia	5460	650	50m inhabitants and above		
10m to 30m inhabitants			Pakistan	66700	130
			Nigeria (ppc)	69524	130
Chile	10408	830			
Peru	14953	740			
Malaysia	11702	680			
Morocco	16291	430			
Colombia	23125	500			
Sri Lanka	13393	130			
Algeria (ppc)	15215	730			
Venezuela (ppc)	11632	1960			

(ppc) = petroleum producing country

List of the 96 countries and 18 territories without a capital goods industry

Country	Population (thousands)	Per capita GNP ($)
50,000 to 300,000 inhabitants		
Bahamas	199	2460
Bermuda	56	5300
Belize	136	690
French Guiana	58	1470
Netherlands Antillea	238	1590
Virgin Is.(USA)	88	5080
Cape Verde Is.	290	470
Comoros	265	230
The Afars and the Issas	103	1720
Sao Tome and Principe	79	570
Seychelles	56	520
Ceuta and Melilla	126	720
Qatar (ppc)	190	7240
Brunei (ppc)	150	6630
Macao	270	310
Maldive Is. (ldc)	116	100
Antigua	71	540
Barbadoa	241	1200
Grenada	108	330
Dominica	75	410
St. Kitts-Nevis-Anguilla	46	500
St. Lucia	108	530
St. Vincent	91	340
Bahrain (ppc)	245	2350
Solomon Is.	183	310
West Samoa (ldc)	157	300
French Polynesia	134	2530
New Caledonia	132	4170
Guam	105	4420
Tonga	97	300
New Hebridea	94	480
Gilbert and Ellice Ia.	59	730
American Samoa	29	1100
Truat Territory of the Pacific Is.	103	500
300,000 to 500,000 inhabitants		
Guadeloupe	350	1240
Martinique	358	1540
Equatorial Guinea	318	290
Réunion	490	1550
Surinam	387	1180
Gabon	528	1960
Swaziland	478	390
Malta	320	1220
500,000 to 1m inhabitants		
Guyana	791	500
Mauritiua	871	580
Botswana	654	290
Guinea-Bissau	520	390
Namibia	860	800
Oman	750	1660
United Arab Emirates	548	11060
Gambia (ldc)	506	170
East Timor (ldc)	650	150
Kuwait (ppc)	930	10030
Fiji	564	840
1m to 5m inhabitants		
Lesotho (ldc)	1191	140
Bhutan (ldc)	1150	70
Benin (ldc)	3027	120
Mauritania	1290	290
Niger (ldc)	4480	120

List of 96 countries, etc. (cont'd)

Country	Population (thousands)	Per capita GNP ($)
1m to 5m inhabitants		
Senegal	4869	330
Sierra Leone	2911	190
Somalia (ldc)	3100	90
Democratic Yemen (ldc)	1632	220
Dominican Rep.	4562	650
Jamaica	2008	1190
Trinidad and Tobago	1070	1700
Lebanon	3065	1070
Haïti (ldc)	4514	170
Panama	1618	1000
Costa Rica	1921	840
Jordan	2620	430
Zambia	4781	520
Liberia	1500	390
El Salvador	3887	410
Honduras	2806	340
Togo	2176	250
Paraguay	2484	510
Nicaragua	2041	670
Malawi (ldc)	4958	130
Central African Empire (ldc)	1748	210
Chad (ldc)	3952	100
Rwanda (ldc)	4058	80
Burundi (ldc)	3655	90
Congo	1300	470
Libyan Arab Jamahiriya (ppc)	2352	4440
Papua New Guinea	2650	470
5m to 10m inhabitants		
Guinea (ldc)	5390	120
Angola	6050	710
Ivory Coast	6387	460
Mali (ldc)	5560	80
Upper Volta (ldc)	5760	90
Yemen (ldc)	6379	180
Cameroon	7120	250
Uruguay	2754	1190
Syria	7177	560
Ghana	9610	430
Mozambique	9030	340
Madagascar	8560	180
Bolivia	5470	280
Guatemala	5284	580
Khmer Rep. (ldc)	7725	70
Saudi Arabia (ppc)	8008	2830
Ecuador (ppc)	6952	480
10m to 30m inhabitants		
Iraq (ppc)	10770	1110
Nepal (ldc)	12320	110
Kenya	12910	200
Uganda (ldc)	11186	240
Tanzania (ldc)	14351	160
Afghanistan (ldc)	16311	110
Burma (ldc)	29521	100
Ethiopia	27240	100
Sudan (ldc)	15227	230
Zaïre	24071	150
More than 50m inhabitants		
Bangladesh (ldc)	76200	100
Indonesia (ppc, ldc)	128400	170

Source: World Bank Atlas, published by the World Bank in 1976.

Note: All figures refer to 1974. Countries with centrally planned economies are not included in the list. Colonies and territories are listed separately from the countries to which they belong.

(ppc) = petroleum producing countries
(ldc) = least developed countries

II. A NATIONAL CAPITAL GOODS STRATEGY AND THE MASTERY OF TECHNOLOGIES

2.1. Organisation of the productive apparatus

In the previous chapter we advanced the concept of technological production routes, characterised by:

- design,
- technical manufacturing processes which, starting from simple products (materials, components, sub-assemblies), permit the production of a final product,
- the management of production and marketing.

An approach to the capital goods industry on the basis of technological production routes has made it possible to classify products by routes and sub-routes, so showing the possibilities of analogue grouping of products. Each of the sub-routes is characterised by an index of complexity and of size of the productive equipment.

The problem which is definitively posed for the capital investment decision is therefore: how to organise the productive apparatus.

Three very contrasted strategies are, a priori, possible:

- organisation on the basis of a standard workshop,
- organisation on the basis of integrated production units corresponding to a product,
- organisation on the basis of technological production routes and/or analogue grouping of the products.

2.1.1. Standard workshops

The concept of a standard workshop or "resource element" has been developed in papers from the University of North Carolina, and has been the subject of a UNIDO publication[1]. This work involves breaking down the product into as many operations as is necessary, and then allocating to each operation a workshop (or resource element) with its specific characteristics. This method has the advantage of taking into account all the possible linkages between products and processes, and consequently of profiting to the maximum from external economies. This method is intellectually attractive as a planning method, but in the absence of further verification it does not seem to have given rise to concrete applications, at least in its integral form. If this is not so it would be advisable to know why.

2.1.2. Integrated production units

These units are designed for one product or one family of products (for example units for pumps, valves, gantries, cranes, tractors or engines). A unit therefore integrates the whole of the technological production route and, in particular, the technical manufacturing processes (casting, forging, heat treatment, machining), together with the manufacture of components such as gears or sub-assemblies such as reducers.

These units correspond to "turnkey" or "finished product" capital investments with a fairly high level of integration.

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(1) Planning and programming of the metalworking industries with a special view to exports. 1972. E/72/II/B 7.

In this way one can see the advantages:

- For a country which has no industrial experience a complete unit is established under the responsibility of the general contractor or the foreign investor.

- As no basic manufacturing processes (casting, forging, heat treatment) will, a priori, exist in the country, all these basic routes are purchased with the unit.

- As there is no capacity for designing such a factory in a highly developed form this design is also purchased.

One can also see the disadvantages:

- The multi-purpose character of the basic processes is not used, or can only be subsequently used with difficulty in order to supply parts and components for other industries.

- The units may be fairly complex and management difficult.

- Dissemination of the techniques can only be carried out with difficulty, since they are concentrated in a single place. There is no enlargement of the industrial fabric.

- There is no apprenticeship in the design and production of projects.

2.1.3. Technological production routes and analogue grouping of products

It appears that this approach has still not been systematically studied. There are examples, either for the production of heavy machinery (Heavy Machine Building Plant) as in India, Pakistan and Iran, or for the production of small equipment for agriculture and the building industry (simple forging and casting), or for the maintenance and manufacture of some spares (mechanical machining workshops).

It therefore seems to be of value to explore the possibility of the creation of a capital goods industry on the basis of the establishment of technological production routes and the analogue grouping of products for the hundred developing countries which have no capital goods industry.

In effect the initial correspondences between final demand, technological route and complexity have now been established. It has been seen that mastery of a capital goods industry is effected more by the mastery of one route than by the mastery of a product. Furthermore local artisan capacities can be used and improved, and this represents a favourable circumstance for mastering the new techniques which are introduced.

This is perhaps a slower way, but one which will not be "telescoped" by numerous external stresses which propose, as a "packet", either products, production processes or management. The analysis of experiences in countries such as Bulgaria and Hungary can be of value in this respect.

Finally feasibility studies taking into account an analogous group of products are very different from product by product feasibility studies. It should, however, be observed that this method runs the risk of not receiving the support of the industrialised countries (study of projects, financing, etc.), since the specialisation of the companies in these countries does not make it easy for them to think of several products simultaneously.

In conclusion, therefore, there can be no miracle solutions but specific choices have to be made, case by case, where the type of product, the market and the level of development which has already been reached by the country come into play.

<u>However in the case of the hundred countries which do not have any capital goods industry it appears to be preferable to carry out studies on the technological production routes and analogue grouping of products</u>.

2.2. A national engineering capability policy

2.2.1. The central rôle of engineering capability

A decisive element in the industrial, technological and commercial domination of the industrialised countries is the existence of engineering capability.

The engineering function has been defined as follows[1]:

"All the methods and organisational structures making it possible to master the interdependence of the scientific, technical, technological, economic and financial information which is necessary for the design and optimal realisation (cost and construction times, operating costs) of capital in a coherent productive unit".

The engineering function develops as a result of the technical progress which it contributes towards developing.

This is why in several countries it does not cover exactly the same definitions, since the latter take this evolution more or less into account.

As a result of the increasing size of the units to be established and the growing complexity of the techniques to be mastered the function of design and realisation must be distinguished from the function of production.

This evolution is the consequence of passing from the design of an industrial complex to that of a total system. It is also a consequence of the evolution of methods of teaching in the design of machines. Teaching of "Machine design" covers mainly the theory of machines and the strength of materials.

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(1) J. PERRIN. IREP Grenoble - Engineering: Terminology and economic function. Special study no. 9 (CD/TI (76) 1) for the Development Centre of the OECD - Paris.

That of "Engineering design" covers these elements, but integrates them into a larger grouping defining a new profession.

Engineering constitutes a crossroad where dynamic linkages are established with research and development, production, the manufacture of capital goods and financial institutions.

Under these conditions a capital goods policy in the developing countries presupposes a strategy of establishing and developing a national engineering capability. It is a question of progressively mastering the technological routes corresponding to the levels of entry of the countries in the capital goods industry and subsequently dominating the more complex operations and the groupings of wider activities.

Engineering has a high priority since it is both the crossroad and "memorising" of information.

At the time when investments, as a result of the complexity and increasing interdependence of techniques, resulted in difficult implementation, engineering was regarded simply as an agent of this organisation. Engineering is directed towards optimisation: optimisation in terms of deliveries and costs of the parts and sub-assemblies forming the whole of a construction, optimisation in the functioning of this construction in terms of quality and product costs. Engineering can be seen in this way to be at the centre of a to-and-fro process between those poles which structure an industrial system, having complex relationships with these poles which it is of value to explain.

Engineering and production

Industrial promoters call on engineering to reduce the delays of entering into production and to optimise production. The impact of engineering on production is direct, inasfar as the performance of a production unit (the characteristics of the product and the operating

costs) are determined partly by the volume and quality of the engineering work. The rôle of engineering is important not only in the implementation of the process but also in its incidence, in particularly sensitive fields, in countries which are becoming industrialised: maintenance, handling, the defining of stocks of spares. Furthermore it is the producers who have become the inventors of machines: production is the location of industrial experience, and the practitioners of production are well placed to identify the improvements to be made in processes, the conversions to be applied to the design of machines, and to formulate the problems to be resolved. Engineering allows this experience to accumulate, to become rationalised, to rise to the level of research and development and finally to become integrated into the design of new units. Engineering is at the same time the agent of the accumulation of this advance and of the dissemination of industrial experience. In many countries and regions, lacking or almost entirely lacking research infrastructures, engineering probably constitutes the determinant factor for the installation of an initial research and development network.

Engineering and the construction of capital goods

Engineering, as the agent for managing capital, conceives and organises a coherent assembly of machines and equipment. The link between engineering and the manufacture of equipment goods is a close one.

Initially engineering specifies the necessary equipment and takes part in drafting the call for tenders and in the choice of equipment; it supplies the principal specifications on which the design offices of the manufacturers produce their working drawings; during manufacture it controls and advises before acceptance. By the very nature of things the result is that each engineering company maintains preferential links with certain chosen manufacturers. The result is that the manufacture of equipment goods integrates engineering.

One can measure, within this context, the importance of the nationality of the engineering company. On this point the Indian example is a significant one; it shows that the linkage between massive investments in the iron and steel industry and the national heavy engineering industry was not established in this country until after the creation of a national iron and steel engineering organisation. This national engineering organisation became informed as to the capacities of the heavy engineering production units, and agreed to participate in the strengthening of their design offices so as to allow them to meet those orders which were passed to them within the required time.

On the contrary, and where a national engineering capability is lacking, the creation of industrial units is shown by a usage of foreign equipment goods which is sometimes more than is necessary.

Engineering and Research and Development

Engineering does not have any direct relationships with fundamental research but, by contrast, is closely linked with Research and Development. Research and Development provides, in practice, the processes which engineering then puts into operation. An engineering organisation may therefore come to integrate a Research and Development department; more frequently, however, it maintains a "branch" intended to facilitate permanent contact with the rapid developments of research. Engineering puts into effect the results of research work: it is at the forefront of its latest advances, so that it is capable of "exploiting" them at the opportune time. Engineering depends on Research and Development which provides it with "substance", that is to say processes. However Research and Development is in its turn indebted to engineering for the assistance which the latter provides and for the questions which it poses.

As a result of its permanent subjection to the exigencies of production engineering also provides, for Research and Development, a capacity for the interpretation of the results of the technique in economic terms.

Engineering therefore serves as the link between Research and Development and production.

Engineering and the financial pole

In certain types of contract, more particularly turn-key contracts, engineering companies assume financial responsibilities which frequently exceed their own financial capabilities. In the case of difficulties during the realisation of an order the close relations between an engineering company and a bank or a powerful industrial group provides a guarantee for the client. Furthermore, and in order to reply to calls for tenders, engineering companies often find it necessary - particularly within the framework of operations carried out with foreign clients - to offer facilities for financing. For these various reasons engineering companies need to establish relationships with banks, and these relationships are often with one particular bank. Within the framework of an industrial group the financial relationships of the engineering company are established with the holding company of the group or the bank for the group.

If engineering companies need banks to meet the services required by their clients by contrast the banks find, in these engineering companies, privileged partners when carrying out their commercial and financial operations.

Engineering and the construction of an industrial system

Engineering constitutes a stabilising element and an active agent in the integration of the industrial system.

Analysis of the "crossroads" rôle of engineering indicates that the development and promotion of techniques is carried out within the framework of a multi-polar structured grouping. This system is supported by three principal poles: Research and Development, production, and the manufacture of equipment. In the developed countries these three poles maintain direct relationships between themselves, but as a result of the multiplicity and the increasing complexity of the techniques to be mastered when producing a large

industrial complex the relationships between these poles are established by means of a fourth pole: engineering. It is therefore its quality as a collector and a processing agent for technical and economic information which makes it possible for engineering to play its rôle in industrial planning.

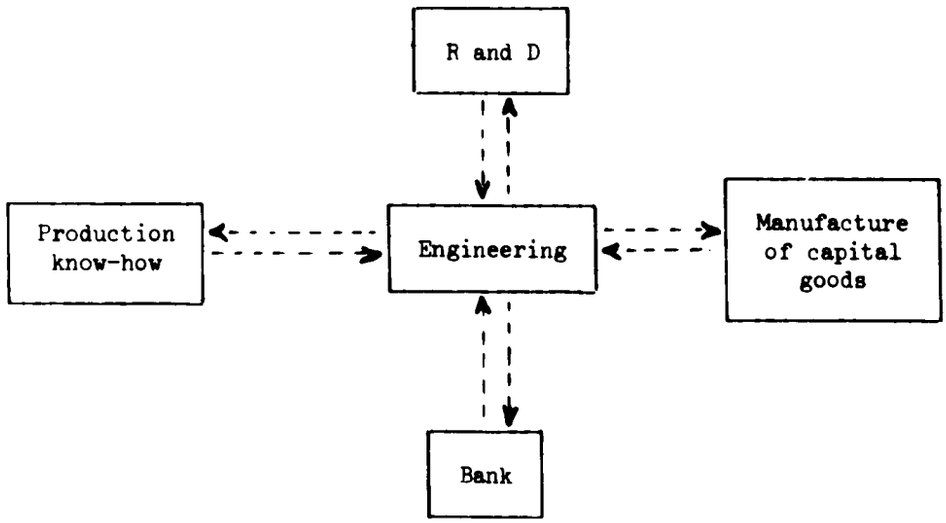
In the developing countries the creation of new industrial units is normally an occasion for the transfer of technologies; in general foreign companies give priority to relationships with the industrial system of their country of origin. They are not orientated towards the development of industrial poles of the countries where they intervene; frequently they ignore them. The intervention of foreign engineering companies in the developing countries frequently contributes towards perpetuating the domination of the developed countries and does not act in the direction of forming a multi-polar structured grouping.

The previous comments emphasize the importance, for the developing countries, of defining and implementing industrial policies which are concerned simultaneously with the promotion of the various poles of industrialisation. The importance of the "integrating" rôle of the engineering pole implies that an effective industrial policy places the emphasis on the creation and development of the engineering function, supported by the linked production of equipment goods, together with the intensification of the relationships which engineering has with the other poles of the system.

At each stage of industrial development this system presents a configuration which is, in particular, defined by the relationships which engineering has with the other poles. According to the state of the relationships between the poles the system is capable of giving rise to a dynamic of industrial development or, on the contrary, to blockage. It appears that engineering, based on the production of equipment goods, is located at the centre of this dynamism or of these blockages.

It is therefore necessary firstly to define the general priorities - in the tasks which a national engineering capability should accomplish in the developing countries - and secondly to define a strategy which conforms with the typology of the countries.

The interrelationships of engineering with the other poles of the industrial system



2.2.2. The priorities

Since it appears that, irrespective of the hypotheses (see Chapter I), industrialisation of the developing countries will be the result of an enormous inflow of technological transfers, the mastery of the latter becomes the central problem in order to dominate the industrialisation movement and the creation of local R and D.

This is why the selection, reproduction and adaptation of technologies is of such primary importance. As a consequence priorities are to be given to the study phases of the latter, that is to say:

- preliminary studies which are frequently delegated, as a result of the lack of adequate internal capabilities, to foreign companies, result in irreversible and uncontrolled technical choices which commit the structure of an industrial project and the determination of certain capital goods;

- implementation studies. These condition the development of the national activity of civil engineering and building enterprises and the production of capital goods which correspond to the implementation of capacities for reproduction of technologies. These various activities necessitate the creation of implementation design offices; design offices linked to building, and design offices linked to the production of capital goods;

- project or "mechanical engineering" studies. The development of project studies then follows. The implementation of the first two priorities is, in effect, a necessary condition if project studies are to develop in a satisfactory manner. At the limit, and if the technical choices which structure an industrial unit and if the capacities for studies which condition the production of equipment goods are not mastered, an engineering company making project studies will be led to depend on the

technical choices made abroad and to issue orders exclusively for foreign equipment.

2.2.3. Possible stages in an engineering capability strategy as a function of the classification of the developing countries

2.2.3.1. Countries which do not have any capital goods industry

- The case of small countries with less than a million inhabitants is a very specific one, since their capital goods industry will remain small. However the mastery of preliminary studies is essential (defining products, the size of units, manufacturing techniques), particularly from the point of view of development based on the satisfaction of basic needs.

- For the other countries, and in addition to mastery of preliminary studies, it is necessary to establish, in an initial stage, the capabilities for producing buildings and civil engineering including metal structural work (studies on simple designs).

2.2.3.2. Countries which have an embryonic capital goods industry

The capacities for mastering preliminary studies must be reinforced and, from this phase onwards, account must be taken of local capabilities for the manufacture of capital goods so as to be able to orientate the foreign engineering companies which are to carry out the investment.

At the same time it is necessary to install or reinforce the capacities for studies and designs in the units producing capital goods.

At this stage the realisation of repetitive projects begins to make it possible to master a series of projects.

2.2.3.3. Countries which have a diversified capital goods industry

The principal objective is the installation of engineering design capabilities closely interlinked with local production of capital goods. This involves mastering the design and realisation of projects. Recourse to countries outside is involved solely in the case of very complex projects. Furthermore it involves the specific linking of engineering and local R and D so as to favour the expansion of the latter.

2.2.4. The training of personnel

At the present stage of the study only some factors can be advanced in respect of these tasks. The training of personnel is involved at several levels:

- at "owner" level[1]: this involves the personnel of the future owners of the plant (public or private entrepreneurs) and the various administrations and, in particular, its design office;
- at "prime contractor" level[2]: this involves the administrative and technical personnel of the engineering companies;
- at the level of companies and equipment manufacturers[3]: this involves the personnel of the technical design offices.

The training of agents does not arise in the same terms at each of these different levels.

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[1] The person or organisation who issues the order for the project.

[2] The engineering consultancy firm or general contractor.

[3] Engineering industries.

. For the agents of the owner's office, it is above all necessary to explain their responsibilities as owner during the various phases of realisation and investment; to bring to light those links which they must establish with the public authorities, the engineering consultants and the enterprises, and to become familiar with the various forms of contract, etc.

. For the engineering companies, it is above all a question of training engineers, project leaders, draughtsmen and administrative staff with additional training in the direction of organisation and the methods normally used in engineering (methods of calculation, methods of management, systems analysis).

. For equipment manufacturers and companies: here it invòlves the rapid training of engineers, project leaders and draughtsmen.

III - CONCLUSIONS

1. The analysis of the typology of countries from the point of view of capital goods completes the analysis by products and final demand. This three-dimensional analysis may be used as a concrete basis for drawing up national strategies and a concerted strategy at a world scale for the production of capital goods. It should make it possible, once the necessary information has been collected, to have available an instrument for action for the policy-makers of the developing countries. It will make it possible to connect the national choices in respect of final demands with the required conditions and characteristics for the production of various groups of capital goods of increasing complexity.

2. The organisation of the national productive apparatus implies a choice between three strategies: standard workshops, integrated production units or technological production routes and the analogue grouping of products. The discussion of the advantages, disadvantages and fields of application of the latter should be pursued.

3. The installation of a national strategy of engineering capability designed to master progressively these technologies is a central activity in a capital goods production strategy for the developing countries.

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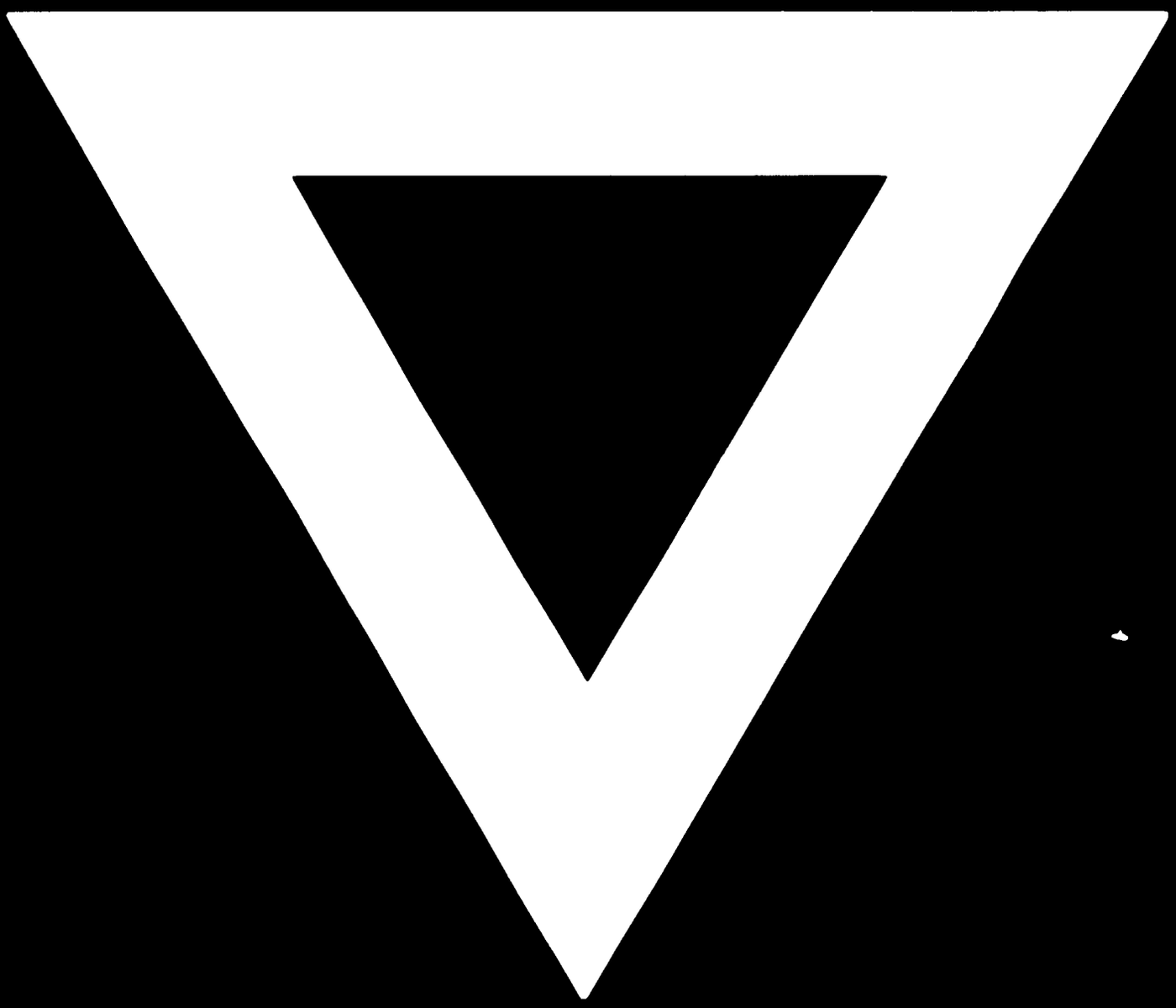

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