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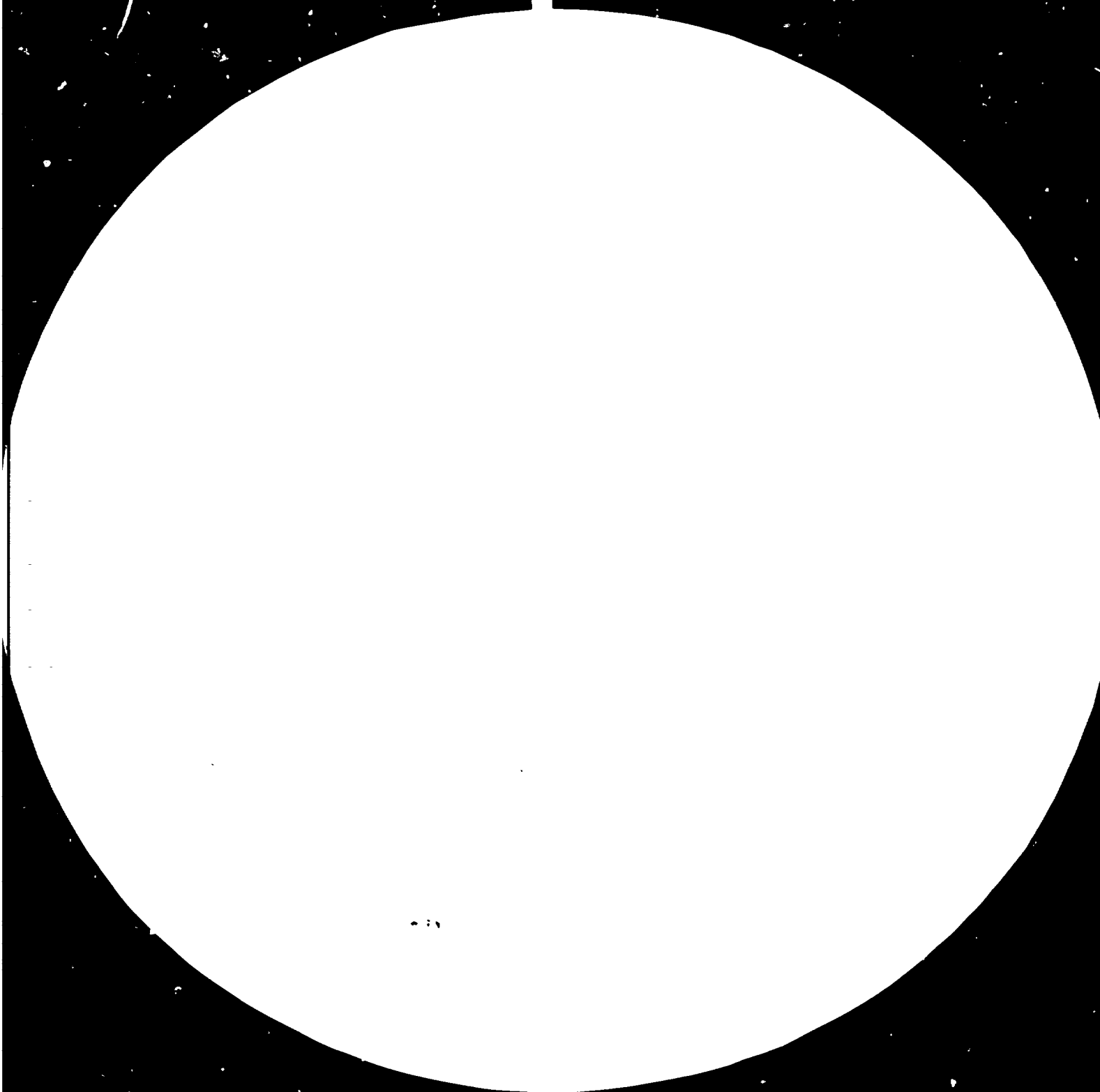
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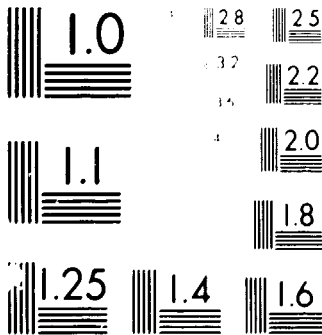
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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna

**METALWORKING
INDUSTRIES
IN DEVELOPING COUNTRIES
OF AFRICA**

*Report of the Workshop on Technical Co-operation
among the Developing Countries of Africa
in the Field of Metalworking Industries*



UNITED NATIONS
New York, 1980

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Use of a hyphen between dates (e.g., 1960-1974) indicates the full period involved, including the beginning and end years.

The following form has been used in tables:

Three dots (. . .) indicate that data are not available or are not separately reported.

ISIC refers to the International Standard Industrial Classification.

SITC refers to the Standard International Trade Classification.

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Introduction

The United Nations Interregional Symposium on the Development of Metalworking Industries in Developing Countries, held in Moscow in 1966, dealt with the general problems of metalworking industries in Africa, Asia and Latin America. At this Symposium it was decided that a series of regional seminars should be held to examine the specific problems faced by the various regions in this field. It was recognized that the development of metalworking industries was based on the machine tools industry since nearly all products were manufactured by machine tools or by machinery that had been produced with such tools. It was also emphasized that the successful development of the engineering industry in developing countries depended not only on the stock of machine tools and other industrial equipment, but also on the way in which these were used in the country since some developing countries had a sufficient stock of equipment that was not being fully and properly utilized.

On the recommendation of the Symposium, the following meetings were organized during 1971-1974:

Regional Seminar on Machine Tools for Europe and the Middle East, Varna, Bulgaria, 1971

Regional Seminar on Machine Tools for Latin American Countries, Buenos Aires, Argentina, 1972

Seminar on the Promotion and Development of the Machine Tool Industries in Countries of Asia and the Pacific, Tbilisi, Georgia, USSR, 1974.

The UNIDO/ECA Workshop on Technical Co-operation among the Developing Countries of Africa in the Field of Metalworking Industries was the fourth in this series. Taking fully into account the present level of the industrial development of the majority of African countries, the Workshop concentrated mostly on the development of metalworking industries and related matters. The main objectives of the Workshop were:

(a) To provide an exchange of experience among the developing countries of Africa in metalworking industries;

(b) To analyse through country study reports, discussions and factory visits the various technical, technological and economic problems related to the development of metalworking industries with regard being given to specific conditions in the African countries;

(c) To identify and promote technical assistance projects with the goal of developing the metalworking industries;

(d) To identify and promote practical technical co-operation among the developing countries of Africa and to facilitate the transfer of technology from developed countries.

In preparation for the Workshop participants from the developing countries of Africa were invited to prepare country study reports on the metalworking industries outlining their experience in this field and pointing out problems. Reports were received from Algeria, Benin, Chad, Ethiopia, Gambia, Ghana, Kenya, Lesotho, Mali, United Republic of Tanzania and Upper Volta.

In the same period, a UNIDO consultant visited selected African countries (Algeria, Egypt, Ethiopia, Kenya, Tunisia and the United Republic of Tanzania) and held discussions with prospective participants from Governments and from the industry. He then consolidated their views in the form of preliminary recommendations, which were later discussed at the Workshop.

I. Organization of the Workshop

The Workshop on Technical Co-operation among the Developing Countries of Africa in the Field of Metalworking Industries was held at Addis Ababa from 14 to 25 November 1977 and was sponsored jointly by the United Nations Industrial Development Organization (UNIDO) and the Economic Commission for Africa (ECA), in collaboration with the Government of Ethiopia.

The Workshop was attended by 28 participants including 17 representatives from 11 African countries, representatives of UNIDO, ECA, the United Nations Development Programme (UNDP), and two experts in metalworking industries from the USSR and Bulgaria. Amde Mariam (Ethiopia) was elected Chairman; S. A. Malai (United Republic of Tanzania) and B. Kelani (Benin) were elected Vice-Chairmen; and R. Eder (Austria) was elected Rapporteur.

At the opening session Habte Marcos (Ethiopia), General Manager of the National Metal Works Corporation, referred to problems facing the growth of the metalworking industries in developing countries, stating that the metalworking industry played a strategic role in the industrialization of developing countries. The Deputy Executive Secretary of ECA said that the Workshop was launched as part of a priority programme of the joint ECA/UNIDO Division responsible in ECA for the development of the engineering industry. He pointed out that the effective development of engineering industries required an industrial upgrading of existing facilities including the formulation of a strategy setting out targets and programmes for short- and long-term development integrated within the context of industrial and overall development.

Speaking on behalf of the Executive Director of UNIDO, the Head of the Engineering Industries Section of UNIDO noted that the Workshop was the fourth in a series of meetings organized by UNIDO for developing countries all over the world. He emphasized that the subject of the Workshop had been chosen with careful consideration being given to the most urgent needs of the developing countries of Africa in the process of their industrial development. He pointed out that the growth of the metalworking industries was of paramount importance for African countries not only because it would provide the basis for sound industrialization, but also because it was crucial for the introduction of technological and socio-economic innovations. It could contribute more than any other industry to training people in technical and managerial skills, to creating production and design capabilities and to improving organizational methods.

Special attention was given at the Workshop to the promotion of technical assistance projects for African countries in the metalworking industries. Participants from a number of countries made suggestions concerning future UNIDO technical assistance programmes in such industries. The programme of the Workshop included visits to major metalworking factories in Addis Ababa, namely, the Ethiopian Iron and Steel Company and the Kaliti Steel Industry. Annex I is a list of papers presented at the Workshop and annex II provides a systematic classification of metalworking industries.

II. The metalworking industries

Definition

The Workshop decided that the metalworking industries (MWIs) could be defined simply by referring to the standard classifications of the industries, or of the products making up the industries, used in many countries throughout the world for the purpose of compiling statistics. Such standard classifications allow analyses and international comparisons.

The most common classifications in use are the United Nations International Standard Industrial Classification of All Economic Activities (ISIC)¹ and the Commodity Indexes for the Standard International Trade Classification (SITC).² Many countries establish statistics according to these works; each has advantages for certain purposes.

In the ISIC classification the metalworking industries are broken down into major groups:

- 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, and measuring and controlling equipment, not elsewhere classified, and of photographic and optical goods

The corresponding classes of SITC are:

- 69 Manufacture of metal
- 71 Machinery, other than electric
- 75 Transport equipment
- 86 Professional, scientific and controlling instruments, photographic and optical goods, watches and clocks

Basic metal industries and metal ore-mining do not form part of the metalworking industries. Other manufacturing industries like jewellery, musical instruments, sporting and athletic goods etc., which are included in group 39 of the ISIC classification, are excluded by definition, although they could well be included. The delimitation of the SITC also has some shortcomings; division 86 includes, for instance, photo-chemical materials.

¹ ST/STAT/M.4/Rev.2, Add.1 (United Nations publication, Sales No.: E.71.XVII.8).

² ST/ESA/STAT/SER.M/34, Rev.2 (United Nations publication, Sales No.: 75.XVII.6).

The engineering industries form a sub-group of the metalworking industries covering mainly non-electrical machinery, electrical machinery and transport equipment (382, 383 and 384 of ISIC).

A systematic, comprehensive and illustrative classification has been drawn up by the Export Industries Section of UNIDO. It comprises 13 major groups and 93 branches of the metalworking industries sector (see annex II).

Although the metalworking industries turn out widely diverse products, there is a marked degree of commonality in the processes, skills, raw materials and equipment used. This commonality justifies the treatment of these industries as a sector.

The metalworking industries in the world economy

The metalworking industries occupy a predominant place in the world economy. Their share in the total value added of manufacturing industries (major division 3 of the ISIC) was 35.5 per cent in 1974 for the world (table 1). Their corresponding share in the gross world product (GWP) was about 11 per cent.

TABLE 1. SHARE OF METALWORKING INDUSTRIES IN TOTAL INDUSTRIAL PRODUCTION, 1955-1974

(Percentage)

Region	1955	1960	1965	1970	1974
World, excluding China and Mongolia	28.6	29.6	32.1	33.9	35.5
Centrally planned economies	24.8	30.1	35.1	39.6	43.6
Market economies	29.7	29.5	30.9	31.3	31.8
Developed market economies	31.6	31.8	33.3	34.0	34.8
Developing market economies	9.1	10.0	11.6	12.5	14.9
North America	34.1	33.0	35.0	33.7	34.8
Caribbean, Central and South America	10.3	13.8	15.0	17.7	21.7
Africa	...	9.2	10.1	8.7	...
Africa, excluding South Africa	...	5.5	5.9	5.3	...
Asia	10.6	17.4	22.0	32.0	34.2
Asia, excluding Israel and Japan	6.4	6.5	9.4	9.0	9.9
European developed market economies	...	31.1	31.9	31.9	31.1
European Economic Community	29.6	30.3	31.6	32.3	31.7
European Free Trade Association	...	33.7	33.9	33.0	34.1
Other Europe	...	20.7	24.5	24.4	...
Oceania	23.3	26.0	27.7	26.3	24.0

Source: United Nations, *Yearbook of Industrial Statistics*, 1974 Edition, Vol. I, New York, 1976.

According to the structure of industrial production given in table 2, the share of metalworking industries in total manufacturing was the largest over the period 1960-1974. The most characteristic shift in industrial production in this period was the growth in the share of the metalworking industries in world industrial production, from 29.6 per cent to 35.4 per cent, compared with that of the chemical industry, from 9.9 per cent to 13.6 per cent and that of electricity and gas, from 5.1 per cent to 6.4 per cent. The shares of other sectors in world industrial

TABLE 2. STRUCTURE OF INDUSTRIAL PRODUCTION, 1960, 1965, 1970 AND 1974
(Percentage)

Sector	ISIC class	World ^a				Centrally planned economies ^b				Developed economies ^c				Developing market economies ^d			
		1960	1965	1970	1974	1960	1965	1970	1974	1960	1965	1970	1974	1960	1965	1970	1974
Total industrial production (ISIC 2, 3, 4)	2-4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
of which:																	
I Mining and quarrying (ISIC 2)	2	8.6	7.9	7.5	7.1	9.8	9.3	8.1	7.2	8.1	7.4	7.2	7.0	21.7	22.6	24.1	22.9
II Manufacturing (ISIC 3)	3	86.1	86.4	86.3	86.5	87.3	87.5	88.5	89.8	85.7	86.0	85.3	85.2	73.8	72.2	69.8	70.3
of which:																	
Food, beverages, tobacco	31	12.7	11.6	10.8	10.2	14.6	13.5	11.7	10.5	12.0	10.9	10.3	9.7	21.6	18.9	17.9	16.5
Textiles	321	5.6	4.9	4.5	4.1	5.3	4.2	3.8	3.4	5.8	5.2	4.8	4.5	11.6	10.3	9.3	8.5
Wearing apparel, leather and footwear	322-324	4.6	4.0	3.5	3.2	5.1	4.2	4.4	3.9	4.4	3.9	3.2	3.0	4.1	4.1	3.5	3.6
Wood products, furniture	33	3.5	3.4	3.0	2.9	4.2	3.8	3.4	3.1	3.3	3.2	2.8	2.8	2.8	3.1	2.5	2.2
Paper, printing and publishing	34	5.8	5.5	5.0	4.6	2.4	2.1	1.9	...	7.0	6.8	6.5	6.2	3.4	3.4	3.5	3.9
Chemicals, petroleum, coal rubber and plastics produce	35	9.9	11.3	12.8	13.6	6.8	8.3	9.2	9.8	11.0	12.5	14.4	15.4	11.2	11.4	11.8	11.7
Non-metallic mineral products, except petroleum and coal	36	4.5	4.6	4.4	4.4	6.0	6.3	6.2	5.9	3.9	3.9	3.6	3.6	3.9	3.9	4.0	4.1
Basic metals	37	7.5	7.4	7.0	6.7	7.7	7.6	7.1	6.4	7.4	7.4	6.9	6.8	3.9	4.1	3.9	4.0
Metal and engineering products	38	29.6	32.1	33.9	35.5	30.1	35.1	39.6	43.6	29.5	30.9	31.3	31.8	10.0	11.6	12.5	14.9
III Electricity, gas and steam (ISIC 4)	410	5.1	5.4	6.0	6.4	2.9	3.2	3.3	3.0	5.9	6.3	7.1	7.8	3.9	4.6	5.5	6.1

Source: The figures are based on data supplied by the United Nations Statistical Office. The structure expresses, in percentages, the distribution of value added of industrial production.

^aExcluding Albania, China, Democratic People's Republic of Korea, Mongolia and Viet Nam.

^bBulgaria, Czechoslovakia, German Democratic Republic, Hungary, Poland, Romania and USSR.

^cCanada, the United States, Europe (other than the centrally planned economies of Eastern Europe), Australia, Israel, Japan, New Zealand and South Africa.

^dCaribbean, Central and South America, Africa (other than South Africa), Asian Middle East and South-East Asia (other than Israel and Japan).

production declined in 1974 compared with 1960. Over the same period the greatest rise in the share of the metalworking industries compared with that of other sectors was registered in the centrally planned economies of Eastern Europe.

It is generally recognized that these industries set the pace for economic development. In this respect it is enlightening to compare the role that metalworking industries have played in the main economic groups of countries. Table 3 gives the shares of the groups of countries in the total value added of the metalworking industries. The respective shares were about 75 per cent for the developed market economies, 21 per cent for the centrally planned economies and about 5 per cent for the developing countries. Value added of the metalworking industries *per capita* amounted in 1970 to \$480 in the developed market economies, \$254 in the centrally planned economies and \$8.4 in the developing countries. The world average was \$126.

Table 1 provides data on the share of the metalworking industries in world industrial production by groups of countries and geographical regions, for 1955, 1960, 1965, 1970 and 1974. The data indicate that during the period the share of these industries in total industrial production rose in almost all groups of countries and geographical regions, the only exceptions being countries of the European Free Trade Association (EFTA), North America and Africa, where the share in total industrial output declined or stagnated.

An overall picture of development between 1960 and 1974 is given in tables 4 and 5. The data in table 4 show that in the period 1962-1974 the growth rates for the output of metalworking industries were high, surpassing those for total industrial production and for most other sectors. However, the metalworking industries did not grow in a uniform fashion; there were periods of accelerated growth and of slow growth, the figures for the annual production growth rates in the period 1960-1974 varying from year to year. As may be seen from table 5, world production rose in all years, but there were marked annual variations in the rates of growth. The data in table 5 also show that during the period 1960-1974 production of the metalworking industries in different groups of countries and geographical regions grew at different rates.

The rapid growth of the metalworking industries resulted in the trebling of their world production in the period 1955-1970.

The share of employment in the metalworking industries in total industrial employment is given in table 6. It rose steadily in the period 1955-1969 and stagnated or declined slightly in the following years.

The metalworking industries in economic development

Empirical analyses have demonstrated that in the early stages of development, structural patterns undergo a rapid transformation. Shifts occur in the composition of production and employment within the manufacturing sector that are similar to shifts in the composition of production and employment in terms of the relative shares of agriculture, manufacturing and services.

An analysis and general explanation of the development of an individual sector should incorporate changes in demand and supply conditions with rising *per capita*

TABLE 3. POPULATION, GDP, GDP PER CAPITA AND VALUE ADDED, BY GROUPS OF COUNTRIES, IN ABSOLUTE AND RELATIVE FIGURES, 1960, 1970 AND 1973

Groups of countries	Year	Population		GDP		GDP per capita (dollars)	Value added of the manufacturing industry		Value added of the metalworking industries		
		Thousands	%	Million dollars	%		Million dollars	%	Million dollars	%	Per capita
Developed market economies	1960	629 712	21.51	1 664 524	67.25	2 643	...	...	...	...	...
	1970	701 920	19.63	2 762 490	67.73	3 936	825 496	71.67	337 078	74.66	480
	1973	724 392	18.99	3 208 502	67.18	4 429	936 746	70.37	...	...	...
Centrally planned economies	1960	330 335	11.28	411 122	16.61	1 245	...	...	...	...	...
	1970	367 482	10.27	648 543	15.90	1 765	208 616	18.11	93 346	20.68	254
	1973	377 831	9.91	739 671	15.49	1 958	239 600	18.00	...	...	...
Developing countries (including China, People's Democratic Republic of Korea and Mongolia)	1960	1 967 817	67.21	399 616	16.14	203	...	...	...	...	...
	1970	2 507 177	70.10	667 416	16.36	266	117 616	10.21	21 053	4.66	8.4
	1973	2 712 285	71.10	827 722	17.33	305	154 745	11.63	...	...	...
Least developed countries	1960	...	...	...	...	...	...	...	...	...	...
	1970	219 963	6.15	22 179	0.54	101	1 779	0.15	...	...	...
	1973	232 272	6.09	22 984	0.48	99	2 205	0.17	...	...	...
World	1960	2 927 864	100.00	2 475 262	100.00	845	...	...	...	...	...
	1970	3 576 579	100.00	4 078 449	100.00	1 140	1 151 728	100.00	451 477	100.00	126
	1973	3 814 508	100.00	4 775 895	100.00	1 252	1 331 091	100.00	...	...	...

Source: Estimates based on data supplied by the United Nations *Statistical Yearbook*, various editions and UNIDO calculations.

TABLE 4. WORLD^a INDUSTRIAL PRODUCTION BY SECTORS, 1962-1974

(Indices and percentage growth rates)

1970 = 100

<i>Branch of activity</i>	<i>Weight 1970 (%)</i>	1962	1963	1964	1965	1966	1967	1968	1969	1971	1972	1973	1974	<i>Annual average growth rate 1962-1974 (%)</i>
Mining and quarrying	7.4	66	69	74	77	81	85	91	94	103	107	114	117	4.9
Food, beverages, tobacco	11.1	68	72	75	79	83	87	91	95	105	109	115	120	4.9
Textiles	4.4	71	74	78	81	85	87	93	98	104	110	117	117	4.3
Wearing apparel, leather and footwear	3.8	74	77	81	83	89	91	96	99	104	110	115	116	3.8
Wood products and furniture	3.3	66	70	75	80	83	86	91	97	106	114	122	122	5.3
Paper printing and publishing	5.3	65	69	74	79	85	87	92	98	102	108	115	116	5.0
Paper and paper products	2.3	62	66	71	76	82	84	90	97	102	110	119	120	5.7
Chemical, petroleum and plastic products	11.5	47	52	58	63	70	76	85	94	106	116	129	135	9.2
Petroleum and coal products	2.0	55	60	65	70	75	81	86	92	105	109	119	122	6.7
Rubber and plastic products	2.3	52	56	61	67	74	78	87	95	107	118	131	134	8.2
Non-metallic mineral products	4.2	61	64	71	75	79	83	89	95	106	114	123	126	6.2
Basic metal industries	7.0	61	65	73	78	82	83	89	98	99	107	118	122	6.0
Metal products, machinery and equipment	34.2	54	58	65	70	77	81	88	96	104	113	126	133	7.8
Electrical machinery	7.6	50	54	58	64	72	77	86	95	105	115	131	137	8.8
Transport equipment	8.4	59	64	69	76	83	85	94	99	107	115	126	125	6.5
Light manufacturing	29.9	67	70	75	79	83	87	92	97	104	110	117	120	5.0
Heavy manufacturing	56.9	54	58	64	70	76	81	88	96	104	112	125	131	7.7
Manufacturing	86.8	59	62	68	73	79	83	89	96	104	112	122	127	6.6
Electricity, gas and water	5.8	52	56	61	66	71	76	84	92	106	116	125	130	7.9
All industry	100.0	65	63	73	76	80	84	89	96	104	112	122	127	5.7

Source: United Nations, *Yearbook of Industrial Statistics*, 1974 Edition, Vol. I, New York, 1976.

^aExcluding Albania, China, Democratic People's Republic of Korea, Democratic Republic of Mongolia and Viet Nam.

TABLE 5. ANNUAL GROWTH RATES OF PRODUCTION OF METALWORKING INDUSTRIES, 1960-1974

(Percentage change from preceding year)

Region	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
World	6.3	10.7	7.5	9.0	9.2	10.9	5.3	8.5	9.3	4.2	4.2	8.6	11.5	5.5
Centrally planned economies	14.5	13.9	11.1	10.0	9.1	10.8	12.0	12.1	10.8	11.3	11.1	11.7	12.0	12.2
Market economies	3.6	8.0	6.4	9.0	9.2	10.1	2.3	7.5	9.0	0.6	1.0	7.2	13.0	1.6
Developed market economies	3.6	8.0	6.4	9.0	9.2	10.1	2.3	7.5	8.3	0.6	0.0	7.0	13.0	0.8
Developing market economies	16.9	7.8	3.1	18.0	9.3	4.7	2.2	10.9	13.7	6.9	10.0	12.7	12.9	15.7
North America	-1.2	11.9	6.4	8.0	13.0	13.9	0.7	5.0	4.1	-8.5	-1.0	8.0	13.9	0.0
Caribbean, Central and South America	16.3	4.0	-3.8	18.0	8.5	7.8	2.2	11.3	13.4	6.7	12.0	16.0	12.3	14.4
Asia	27.0	12.5	11.1	21.0	4.1	13.5	25.2	26.3	21.7	20.7	3.0	7.8	22.5	2.9
Asia, excluding Israel and Japan	17.2	17.3	13.6	19.0	12.6	0.7	0.7	11.8	13.1	7.0	3.0	6.7	15.5	21.3
European developed economies	7.0	4.3	4.2	7.0	4.7	4.5	-0.9	7.7	10.4	7.2	2.0	3.0	7.6	2.7
European Economic Community	7.1	5.5	5.3	4.0	4.8	3.7	-0.9	8.9	13.1	8.9	2.0	3.0	6.7	1.8
European Free Trade Association	2.2	3.2	3.1	9.0	4.6	2.6	0	6.0	6.5	3.8	5.0	2.0	5.6	8.0
Oceania	4.8	-1.1	14.9	13.0	9.7	4.0	4.7	3.7	5.7	2.0	-1.0	4.0	8.6	-5.3

Source: Calculations based on United Nations, *Yearbook of Industrial Statistics*, 1974 Edition, Vol. I, New York, 1976, pp. 636-646.

TABLE 6. SHARE OF EMPLOYMENT IN THE METALWORKING INDUSTRIES IN TOTAL INDUSTRIAL EMPLOYMENT, 1955-1974

(Percentage)

Region	1955	1960	1965	1969	1970	1971	1972	1973	1974
World	23.8	25.3	27.0	28.1	...	28.1	27.6	27.8	...
Centrally planned economies	31.3	31.8	35.1	35.9	36.2	36.6	36.9	37.6	37.5
Market economies	21.8	23.5	24.6	25.7	...	25.4	26.2	25.7	...
Developed market economies	28.6	30.9	32.8	34.3	34.8	34.8	34.5	35.1	33.5
Developing market economies	8.6	10.5	11.9	12.9	...	12.9	13.2	13.3	...
North America	32.2	32.7	35.0	36.8	35.8	35.0	35.1	36.1	36.8
Caribbean, Central and South America	15.2	16.5	17.7	17.6	...	17.9	18.4	18.4	...
Africa	4.6	9.3	12.4	12.8	...	...	...	...	...
Africa, excluding South Africa	1.4	5.1	9.7	11.7	...	...	...	...	...
Asia	10.0	13.7	15.3	17.5	...	17.5	17.4	17.2	...
Asia, excluding Israel and Japan	6.9	9.0	10.4	11.7	...	12.5	12.7	12.7	...
European developed market economies	29.0	31.3	32.9	33.5	34.4	34.4	34.0	34.7	34.7
European Economic Community	28.6	31.1	33.1	34.4	35.3	35.7	34.9	35.3	35.7
European Free Trade Association	32.9	34.4	35.8	36.9	37.3	37.3	37.3	38.0	38.3
Other Europe	15.5	21.5	23.6	22.4	24.0	...	...	...	...
Oceania	28.9	31.5	33.6	34.3	...	34.0	34.0	33.6	...

Source: Calculations based on United Nations, *The Growth of World Industry*, 1969 Edition, Vol. I, New York, 1971 and United Nations, *Yearbook of Industrial Statistics*, 1974 edition, Vol. I, New York, 1976.

income. With regard to supply, the increase in capital stock per worker and the increase in skills of all kinds are important. Changes in supply conditions generally lead to the substitution of domestic production for imports and of factory goods for handicraft goods.

Changes in the composition of demand have an important bearing on industrial development, especially in the metalworking industries, and the income elasticities for the group of metal products are generally much higher than for other sectors. The explanation is simple. In developing countries the large majority of the population spends its income on basic needs such as food, clothing and housing. Increasing income will make for rapid saturation so far as basic needs with rapidly decreasing marginal utility are concerned. The income left after saturation of basic needs will be directed towards new goods.

The metalworking industries offer continuously improving new goods and constantly create new and greater demand. This is the main reason why production and employment have been growing in this sector at the same time that the share of other sectors like agriculture has been shrinking.

Furthermore, the metalworking industries perform a special function as supplier of capital goods to all sectors, contributing about one third of all gross capital formation. Consequently, a relatively larger share of final demand comes from investment into, rather than from consumption of, the products of the metalworking industries.

In many developing countries the size of the present market is still small in relation to the present stage of technology. The promotion of exports therefore appears to be the principal means of overcoming the problem; the substitution of domestic production for imports offers possibilities only to larger countries. However, the benefits of economies of scale and of external economies could also accrue to a group of less industrialized countries as a whole, if appropriate arrangements were made for effective co-ordination of investment decisions for the development of the metalworking industries. Regional co-operation makes it possible for a group of countries to start an industry through import-substitution even though an individual country could not pursue this strategy successfully alone.

The development of the metalworking industries implies the introduction of new technologies and the formation of new skills. It provides the opportunity of increasing experience and of learning in a new field, which is a precondition for further progress.

The structure of metalworking industries

The sector of metalworking industries is probably the most complex of the industrial sectors. Practically no country is able to produce all the required metal products while maintaining the highest or at least a high technical level. Nearly all countries are thus forced to purchase a fairly large amount of metal products from other countries.

Most countries, but especially developing countries, face constraints preventing them from producing certain products. If a country does not dispose of the required technology, know-how and skills, it is automatically excluded from producing some products. Even among the great number of products that can be produced from the point of view of technology, a choice must be made. The choice may be based on purely economic criteria (optimum allocation of resources) or other (strategic) considerations. The total number of choices made in the past determines the structure of the sector, or the composition of the sector by product, although the choice for investment is generally made at the project level.

As most available statistics pertain mainly to the ISIC groups of products, the three-digit ISIC classes have been used in determining the structure of the metalworking industries, which is reflected in the percentage shares of major groups of products in the metalworking industries. Based on the structure of metalworking industries in about 25 developed market economies, a typical structure of metalworking industries was calculated, representing an average which could be called "typical" because it could serve as a rough indicator of future development for developing countries, but not as an immediate development target. In addition, the average structure was calculated for about 96 developing countries.

In table 7 the typical structure of developed countries and the average structure of developing countries are given together with the structure of metalworking industries in selected developing countries. These latter countries are arranged in order of the percentage share of metalworking industries in total manufacturing in 1970, beginning with Tunisia, the country with the lowest share of metalworking industries in total manufacturing.

TABLE 7. THE TYPICAL STRUCTURE OF METALWORKING INDUSTRIES IN THE DEVELOPED COUNTRIES, AND IN SELECTED DEVELOPING COUNTRIES, AND THE AVERAGE STRUCTURE IN THE DEVELOPING COUNTRIES
(Percentage)

ISIC class	Typical structure in developed countries	Tunisia		Ghana			United Republic of Tanzania		Benin	Egypt	Algeria	Kenya		Average structure in the developing countries
		1970	1972	1970	1972	1973	1970	1973	1970	1970	1970	1970	1974	
381	22.8	44.2	50.8	41.7	36.6	26.5	41.6	25.7	61.9	35.0	41.1	30.0	29.8	46
382	26.5	—	—	1.5	1.0	—	18.4	6.4	23.8	15.7	7.2	3.9	7.8	11.5
383	20.0	32.6	22.1	18.8	25.7	18.3	10.1	22.5	4.8	27.0	18.9	24.6	19.1	17.5
384	27.6	23.2	27.0	37.7	36.2	55.2	29.9	45.4	9.5	21.0	28.0	41.7	43.2	23
385	3.1	—	—	0.3	0.5	—	—	—	—	1.0	4.7	—	—	2
All metalworking industries	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Percentage of metalworking industries in total manufacturing		6.7	7.5	6.8	6.0	10.4	8.4	11.2	10.0	13.0	21.1	25.9	18.2	

Source: Calculations based on unpublished United Nations statistics.

Note: Countries arranged in order of the percentage share—lowest to highest—of metalworking industries in total manufacturing in 1970.

If the structure of metalworking industries is taken as an instrument of development policy and planning, the following observations may be made:

(a) The typical structure of metalworking industries in developed countries cannot be regarded as the ideal structure; it is calculated as the average structure of metalworking industries in 25 developed market economies, with equal weight being given to each country;

(b) Even within the group of the 25 developed countries, deviations from the typical structure are registered;

(c) Each country apparently has its individually optimum structure, taking into account endowment and demand;

(d) In this sense, the actual structure of a developing country may represent an optimum, although it might be very different from the typical structure;

(e) The optimum structure of the market economies may be considered to be achieved when the internal rate of return of the best project(s) in each ISIC group is equal for all ISIC groups;

(f) A comparison of the average structure in developing countries with the typical (average) structure in developed countries shows:

(i) That the share of simple metal products (381) is relatively high in developing countries (46 per cent compared with 22.8 per cent in industrialized countries);

(ii) That the share of the product groups requiring a more sophisticated technology is lower in developing countries than in developed countries, the difference depending on the degree of sophistication;

(g) In the selected African developing countries the structure of metalworking industries varies widely from country to country and from one year to another. This is owing to the lower stage of development of the sector in these countries in which the implementation of a single medium-sized project may change the whole structure.

The observations made above do not lead to conclusions concerning priorities to be given to certain groups of products. It may be recommended that a group of products not be neglected on purpose. Investment decisions are probably better if based on the evaluation of individual projects than if based on priorities given to certain groups of products.

III. The metalworking industries in selected African countries

Algeria

Algeria, which has a population of about 15 million, has the highest annual *per capita* GDP, \$570, among the countries selected. At the same time the contribution of metalworking industries to GDP (2.8 per cent) and their value added *per capita* (\$12.30) are highest in this country. With regard to employment in metalworking industries as a percentage of the total population (0.24 per cent) only Tunisia (0.5 per cent) surpasses Algeria. In absolute terms the value added of metalworking industries amounted to about 750 million Algerian dinars (DA) or \$180 million in 1973. More recent statistics are not available on value added. The share of metalworking industries in total manufacturing is relatively high, 18.2 per cent, indicating that Algeria has reached a considerable level of development. According to the development plan, the metalworking industries are expected to double their value added in 1977 compared with 1973 and to increase their share in total manufacturing to 20 per cent.

The work force employed in metalworking industries numbered about 15,000 in 1966, 35,000 in 1973 and 44,693 in 1975.

The metalworking industries have progressed rapidly and comprise a considerable number of products. The product list includes: gas cylinders, tanks, heaters, liquid pumps, cranes, wagons, trailers, tractors, metal framings, cutlery, metal furniture, lorries, motors, mopeds, bicycles, wires, television sets, radios, heating fans, irons, cookers etc.

Algeria has iron and steel plants and steel rolling mills.

Although the production of most products had been growing, considerable fluctuations have been recorded for some products. No information is available on the reasons for this phenomenon.

Benin

Benin is one of the 29 least developed countries. It has an area of 112,000 km² and its population numbered 3.1 million in 1975 (2.9 million in 1973), giving a density of 27.5 inhabitants per km². Its *per capita* GDP was about \$110 in 1973 and about \$136 in 1975.

The contribution of metalworking industries to GDP is very small: 0.17 to 0.3 per cent. The share of industry in GDP was about 8.7 per cent in 1975 (estimates vary depending on the data used). The share of metalworking industries in total manufacturing is estimated to amount to about 3.5 per cent. The value added of metalworking industries *per capita* is roughly \$0.20.

The total value added of metalworking industries was \$632,000 in 1975 compared with \$328,000 in the previous year. But the strong increase from one year to the other can hardly be considered as reflecting a tendency of continuous growth, because in 1971 the value added reached \$376,000 and dropped in the following two years to less than 50 per cent of this figure. No information is available on the reasons for this fluctuation. The population of working age is estimated to be 1,240,000 out of which 3.4 per cent have paid jobs. The employment in metalworking industries was 297 persons in 1975, corresponding to about 0.009 per cent of the total population.

The present production of metalworking industries comprises: tanks, containers, construction of mild steel articles, nails, agricultural implements, structural work, assembling of bicycles, motor cycles and other motor vehicles, tinware, trailers, repair of ships, metal doors, window frames and aluminium utensils.

In the past, metalworking activities have been limited mainly to maintenance and repair, thus explaining the proliferation of mechanical workshops. The country has never had a serious educational policy with well-defined objectives with regard to technical specialization.

Chad

Chad is one of the countries for which almost no statistics are available. The population is about 3.9 million. *Per capita* GDP is one of the lowest and is estimated to be around \$80. Figures on metalworking industries are not available. It is reported that some of the few existing establishments in the metalworking industries had to be closed down recently owing to difficulties in marketing the products.

At present the following metal products are manufactured: metal structures and furniture, bicycles and motor-assisted bicycles (assembling), trunks and farm implements. The bicycle-assembling factory employs 94 persons. Some factories are under implementation or still projected. These include the assembly of watches and a mechanical repair shop. In order to facilitate industrial development, the Government has set up the Chad Industrial Promotion Office.

The development of metalworking industries in Chad depends mainly on the general economic development. Obstacles to economic development are: transport problems, the limited market and lack of skills.

Egypt

Egypt has the largest population (35.6 million) of the countries included in the present study. Its *per capita* GDP (\$250) is slightly above the average of \$220. The contribution of metalworking industries to GDP (2 per cent) is third after Algeria and Kenya. The value added of metalworking industries *per capita* (\$5) is somewhat higher than the average. The contribution of metalworking industries to total manufacturing has been 11 per cent for the past six years, while production has grown over the period (1970-1975) by 54 per cent at constant prices. Figures on employment are not available.

Local production is registered in all three-digit ISIC groups of products, but their shares vary widely. The two largest categories, structural steelwork and steel

furniture, account for about 40 per cent of the total production of metalworking industries. However, the production of many other metal products is also highly developed.

The main problems encountered in metalworking industries are: underutilization of capacities in some branches (television, boilers, structural steelworks); higher labour costs than in Europe as a result of overmanning and low productivity; shortages of all kinds of skills because of the brain drain to other Arab and African countries and from private firms to government bodies; and delays and other difficulties in importing raw materials because of foreign-exchange restrictions. There is some evidence that the Government is aware of the problems and that it will deal with them.

Ethiopia

With a population of 26.6 million, Ethiopia is one of the larger African countries. Its *per capita* GDP, however, is low, under \$100. The contribution of metalworking industries to GDP is around 0.6 per cent; the value added of metalworking industries *per capita* amounts to \$0.5.

Employment in metalworking industries decreased from 2,194 persons in 1971 to 1,800 in 1975. This is significant for the level of development that employment in food and beverages was 16,500 in the same year.

The metal products manufactured in Ethiopia comprise: nails, wires, corrugated sheets, structure and furniture pipes, sickles, cutlery, hand tools, aluminium household utensils, structural steelworks, metal furniture, tanks, drums, cans, buckets, foundry products, aluminium window and door frames.

The development of metalworking industries in Ethiopia has been based on import substitution. Major problems seem to be: lack of raw materials, insufficient size of markets, lack of skilled manpower and problems in getting spare parts. The recently established National Metal Works Corporation is in charge of administering existing nationalized factories and developing new industries. It may be expected that priority will be given to metalworking industries in the future.

Gambia

The Gambia is the smallest country among those selected. It has a population of 500,000. The *per capita* GDP is low (\$120).

There are few statistics on the metalworking industries even in the new development plan. In fact, they are not important. The existing units are mainly repair shops attached to other factories. Nevertheless, there are good training facilities. The actual production is limited to steel structures, metal furniture, containers and some spare parts.

Ghana

The population of Ghana is about 9.3 million. The *per capita* GDP (\$300) surpasses the average of \$220. No data are available on value added of, or employment in, metalworking industries.

The list of metal products manufactured in the country includes: nails, shovels, window frames, containers, enamelled utensils, aluminium utensils, galvanized iron products, pots, trunks, cutlery, corn mills, metal furniture, office pins, assembly of tractors, motor cycles, bicycles, trailers, tankers, low loaders, and tipper-truck bodies. Ghana also has workshops for servicing mining and railway equipment.

Kenya

With a population of approximately 12.5 million, Kenya realized in 1973 a *per capita* GDP of \$170, which might have grown to \$260 by 1976. The contribution of manufacturing industries to GDP grew from 13.4 per cent in 1973 to 14.4 per cent in 1974 and decreased again in 1975 to 13.3 per cent and in 1976 to 12.9 per cent. The share of metalworking industries in GDP developed the same way. It grew from 2.6 per cent in 1973 to 2.9 per cent in 1974 and went down to 2.4 per cent in 1975 and to 2.3 per cent in 1976. The drop is at least partly explained by the fact that some of the metalworking activities, such as the repair of cars, were transferred to the services sector.

The value added of metalworking industries *per capita* exceeds \$4. The number of employed in metalworking industries is about 25,000 persons, representing 0.2 per cent of the total population.

The metalworking industries manufacture or assemble mainly the following products or product groups: cutlery, hand tools, metal furniture, structural steel, fabricated metal products, electric motors, transformers, switch gears, radios, television sets, telephone equipment, fans, vacuum cleaners, heaters, insulated wires, electric lamps, motor cycles, bicycles, motor vehicles, railway rolling stock etc.

In Kenya, the metalworking industries have developed to a considerable extent, but in spite of their performance they have been facing severe problems. The major ones are: scarcity of management and technical skills, lack of local raw materials, and difficulties in identifying and selecting appropriate technology.

Lesotho

Lesotho is a small, but densely populated country of 1.2 million inhabitants. About 200,000 citizens live outside the country, mainly as migrant workers in South Africa. *Per capita* GDP is low (\$120), but it has almost doubled with the addition of income that citizens of Lesotho earn abroad.

No statistics are available on metalworking industries and other sectors. There is some local production of water buckets, bins, stove-pipes and ox-carts, window frames, door frames and gates.

In order to accelerate development, the Government has established the Lesotho National Development Corporation and the Basotho Enterprise Development Corporation.

Mali

Mali has an area of 1,240,142 km² and a population of 5.4 million, on a density of only 4.5 persons per km². The *per capita* GDP is among the lowest of African countries, amounting to \$70 in 1973. The value added of metalworking industries

was \$1,132,000 in 1974, or about \$0.20 *per capita*. The contribution of metalworking industries to GDP was 0.3 per cent. In 1975, 1,062 persons were employed in metalworking industries, corresponding to 0.017 per cent of the total population.

The activities of the metalworking industries may be summed up as follows: assembly of agricultural equipment, bicycles and mopeds; the manufacture of spare parts for bicycles; the production of tanks, metal furniture, enamelled and galvanized household articles, nails, metal carpentry, and sheet-metal work and repair. The following obstacles to the development of metalworking industries are listed in the country report: the landlocked nature of the country, the small size of the market, the low tariff protection, the lack of publicity for the activities of the metalworking industries, the problem with spare parts, the lack of complementarity, difficulties of obtaining bank credits, the absence of sufficient incentives and of motivation for investment, price control, and mismanagement of state concerns.

Mali has technical training facilities, vocational training centres, colleges etc.

Tunisia

The population of Tunisia is about 5.5 million. The country has a relatively high *per capita* GDP, \$467. The metalworking industries contribute about 1.3 per cent to GDP. Their value added *per capita* comes to \$6.12.

The employment in metalworking industries as a percentage of total population (0.5 per cent) is the highest of the 13 countries represented. This fact may be explained by the relative stability of the sector for many years. The new development plan has a growth target of 15.5 per cent for metalworking industries, while the corresponding rates for total manufacturing and GDP are 11.7 per cent and 7.5 per cent respectively. In 1976, the metalworking industries employed 27,550 persons. The sector should play an even more important role in the creation of new employment, 5 per cent of which is expected to be generated by the metalworking industries.

The most striking problem is probably the underutilization of installed capacities. But there must be other problems, giving rise to this underutilization. Tunisia has its own iron and steel works to supply the sector with raw material.

The list of manufactured metal products comprises all major groups, but only the most common products are made.

United Republic of Tanzania

The United Republic of Tanzania has about 14 million inhabitants. Its *per capita* GDP (\$130) is lower than the average. The contribution of metalworking industries to GDP (0.9 per cent), the value added of metalworking industries *per capita* (\$1.13) and the employment in metalworking industries as a percentage of total population (0.034 per cent) are also less than the averages for the African countries represented. But the share of metalworking industries in total manufacturing is rather high (13.5 per cent). The value added of metalworking industries has been growing at an annual rate of 22 per cent since 1966. Production comprises a considerable number of products, among them: metal furniture, structural metal products, agricultural

machinery, radios, television sets, electrical apparatus, ships, motor vehicles, motor cycles, bicycles, and heaters.

Some factories are equipped with modern machinery; others have poor equipment.

Some of the main problems of metalworking industries in Tanzania are: installed capacities are often underutilized (35 to 50 per cent utilization); the efficiency of local production and the quality of products are modest; there is a shortage of trained manpower; and there are major supply problems both in respect of raw materials and of machinery.

Upper Volta

Upper Volta has about 5.7 million inhabitants and, with Mali, the lowest *per capita* GDP (\$70). The contribution of metalworking industries to GDP is 1 per cent. The value added of metalworking industries amounted in 1976 to \$5.3 million, corresponding to \$0.88 *per capita*. The metalworking industries employ 869 persons, corresponding to 0.014 per cent of the total population.

The current production comprises: metal framing, boilers, farm implements, semi-trailers, metal furniture, aluminium household goods, nails, assembly of bicycles and mopeds, carts and fittings. Manufacture is planned in the near future of railway wagons, and lorry trailers and chassis. New projects include: a grey cast-iron foundry, manufacture of household articles, and manufacture of enamel and stainless steel household ware.

The country report identifies the following problems of metalworking industries: the necessity to import all raw materials; world inflation; long transport distances and slowness of transportation; shortage of cheap energy and water; and poor transport infrastructure.

The Government is concentrating on the manufacture of agricultural equipment and the development of mineral resources. Investment incentives, however, are provided for promoting industrial development in general and for the development of metalworking industries in particular.

Summary

The contribution of metalworking industries to the GDP of the participating countries varies from 0.17 per cent or less to 2.8 per cent. Four countries have a contribution higher than 1 per cent: Algeria, Egypt, Kenya and Tunisia. These countries have at the same time the highest *per capita* GDP of the participating countries.

On the basis of value added of metalworking industries *per capita* the participating countries may be divided into two groups: those with a value added above the average of the participating countries and those with a value added below the average. The average value added of metalworking industries *per capita* in nine of the participating countries for which data were available amounted to \$3.9 in 1973. The average *per capita* GDP of these countries was \$220 (table 7). The corresponding average values for all developing countries were \$8.4 and \$305 respectively (table 3).

It is not surprising that the participating countries with a value added of metalworking industries *per capita* below the average of the nine countries belong to

TABLE 8. RANKING OF 13 DEVELOPING COUNTRIES (1973)

Country	Population (million)	GDP (million dollars)	Per capita GDP (dollars)	Contribution of metalworking industries to GDP (percentage)	Employment in metalworking industries as % of population	Value added of metalworking industries per capita (dollars)
(1) Egypt	35.6	8 820	250	2.0	—	5.0
(2) Ethiopia	26.6	2 290	90	0.6	0.006	0.54
(3) Algeria	14.7	8 340	570	2.8	0.24	12.3
(4) United Republic of Tanzania	14.0	1 830	130	0.9	0.034	1.13
(5) Kenya	12.5	2 150	170	2.4	0.2	4.13
(6) Ghana	9.3	2 760	300	...	...	...
(7) Upper Volta	5.7	410	70	1.0	0.014	0.88
(8) Tunisia	5.5	2 571	470	1.3	0.5	6.12
(9) Mali	5.4	370	70	0.3	0.017	0.18
(10) Chad	5.9	320	80	...	...	...
(11) Benin	2.9	330	110	0.17	0.005	0.19
(12) Lesotho	1.2	120	100	...	...	...
(13) Gambia	0.5	60	120	...	0.003	...
Average			220			3.9
For comparison with an industrialized country:						
Austria (1976)	7.5	40 633	5 400	7.0	2.33	449.0

Source: UNIDO country reports.

the group of least developed countries. Algeria, Egypt, Kenya and Tunisia, with an average of more than \$4, rank highest, while Benin and Mali rank the lowest. For Chad, Gambia, Ghana and Lesotho no data are available.

The figures on employment in metalworking industries as a percentage of the population show a similar result. The three highest ranking countries for which statistics are available show an employment in metalworking industries of more than 0.2 per cent of the population. The corresponding figures for the remaining countries vary between 0.005 per cent (Benin) and 0.034 per cent (United Republic of Tanzania).

The graph shows the correlation between the value added of metalworking industries *per capita* and *per capita* GDP in participating countries. The correlation coefficient is $r = 0.944$. The corresponding equation reads:

$$y = 42.94 x + 68.8$$

where y stands for *per capita* GDP and x stands for value added of metalworking industries *per capita*.

The structure of production of the metalworking industries in the participating countries depends on the *per capita* value added of the sector (see table 8).

The highest-ranking countries have comparatively the most diversified production programme and the highest level of technology.

IV. Summary of findings

The Workshop recognized that the metalworking industries were essential to economic development. Its main features may be described as follows:

(a) The demand for metal products is still increasing all over the world; the point of saturation for metal products is far from being reached and is currently deferred by the creation of new products and improvements of known products;

(b) Its share in GDP increases until a very high level of development is reached;

(c) The demand for metal products is increasing (positively correlated) with the standard of living;

(d) Metalworking industries are labour-intensive and may therefore have a considerable impact on employment;

(e) Technical progress is high in the sector;

(f) According to the product cycle, the technology varies from modest to very exacting. Hence, the sector offers opportunities for modest skills as well;

(g) Far-reaching possibilities of product differentiation in metalworking industries enable manufacturers of different countries to realize an intensive division of labour within the sector and thus to take advantage of economies of scale.

The present share of developing countries in general and of African countries in particular in world production of metalworking industries reflects precisely the different stages of economic development.

The comparison of the value added of metalworking industries *per capita* in developed countries and that in developing countries (about \$480 in developed countries and about \$8.4 in developing countries) shows at the same time:

(a) That the development of metalworking industries—at least to a certain extent—is a must for all developing countries;

(b) That the metalworking industries offer good possibilities for creating employment and for increasing the standard of living.

Judged on the basis of the papers presented by the participants at the Workshop, the following situation and problems are predominant:

(a) African developing countries have the smallest share in world production of metalworking industries and the smallest value added of metalworking industries *per capita*;

(b) There are still countries in Africa in which the sector practically does not exist;

(c) Owing to the low income *per capita*, the present size of the market for metal products is extremely small although the potential size, measured by population, is considerable for some countries;

(d) The technological gap is extremely high. There is practically no local technology in metalworking industries and technology transfer is the main (or only) source;

(e) There is a general shortage of skills, although some countries already dispose of highly qualified labour and higher level skills. Some countries complain of the brain drain to other countries and/or sectors;

(f) Basic metal and other raw material industries are little developed or do not exist in most African developing countries. Therefore raw materials mainly have to be imported, often at comparatively high costs;

(g) The industrial administration, data collection etc. are little developed in some participating countries;

(h) Many participating countries have problems in obtaining spare parts and in the maintenance of machinery.

It is generally felt that the problems of developing countries differ at various stages of development and that it is not possible to prescribe one formula for all developing countries. On the contrary, each country requires its individual strategy, ways and means.

Regional co-operation and the co-operation of international organizations and developed countries may enable developing countries to solve some of their problems.

The selection of the right technology to be applied in a specific country is a difficult but important task.

Taking into account the present situation and problems of the metalworking industries in African developing countries, only a systematic approach can accelerate the development of the sector. This refers mainly to:

(a) Development targets (production targets), taking into consideration regional and international division of labour;

(b) The supply of inputs, development of manpower and of local raw material industries;

(c) Identification of investment projects in metalworking industries;

(d) Allocation of scarce resources in general.

V. Recommendations

It was generally recognized that the prerequisites for the development of the metalworking industries were the proper development of natural resources (basic metal and other raw material industries) and infrastructure (energy, communications, transport etc.).

After extended discussion the Workshop agreed to recommend:

1. That the participating countries should emphasize programming the development of the metalworking industries irrespective of their economic systems by:
 - (a) Setting realistic production targets;
 - (b) Identifying the necessary inputs;
 - (c) Taking into account interindustrial relationships.
2. That the participating countries should systematically:
 - (a) Identify projects in the metalworking industries;
 - (b) Prepare feasibility studies for all major projects;
 - (c) Evaluate the major projects taking into account the overall national development targets.
3. That the participating countries should, with or without assistance from UNIDO, organize survey workshops:
 - (a) To identify problems of the metalworking industries in the specific country or region;
 - (b) To elaborate sectoral development strategies and policies.
4. That the participating countries should collect and process local statistical data on the metalworking industries.
5. That the participating countries should establish metalworking industry centres adapted to the specific requirements of the country. Such centres might be attached to existing factories or institutions.
6. That the participating countries should, in accordance with their development targets, set up industrial pilot/demonstration plants, if other opportunities for in-plant training did not meet the requirements.
7. That the participating countries should, with assistance from ECA, consider regional co-operation in order to take advantage of:
 - (a) A larger market;
 - (b) Common training facilities;
 - (c) Sharing the financing of joint projects.

8. That the participating countries should attach top priority to the question of repair and maintenance. In countries without a metalworking industry it was desirable to start with the establishment of repair and maintenance shops for industrial and farm equipment. Along with the setting up of repair shops at industrial enterprises, centralized repair and maintenance shops should also be set up where necessary, equipped with mobile workshops for providing repair and maintenance for farm and road-building machinery.

9. That the participating countries should prepare and implement a techno-economic programme to improve the efficiency of operating factories mainly by:

- (a) Cost reduction;
- (b) Effective utilization of machinery and equipment;
- (c) Improvement of product quality;
- (d) Proper maintenance and repair of production equipment.

10. That the participating countries should give sufficient incentives to their skilled personnel in the metalworking industry in order to avoid losses of trained manpower.

11. That standardization in the metalworking industries should begin at a very early stage of development in accordance with ISO and that it should possibly be included as one of the objectives of the metalworking industry development centres mentioned under recommendation number 5.

12. That UNIDO should be prepared to assist in the following phases of planning and organizing the development of the metalworking industries:

- (a) Identification of metalworking industry projects (types of products to be manufactured);
- (b) Preparation of feasibility studies;
- (c) Evaluation of metalworking industry projects for investment decisions;
- (d) Construction of plants;
- (e) The production process.

13. In particular, it was recommended that the participating countries should submit requests for the following UNIDO technical assistance projects:

Ethiopia

- (a) Assistance in formulating development programmes for the metalworking industries;
- (b) Assistance in the design and construction of grain silos of different capacities.

Gambia

- (a) Assistance in the upgrading and development of the metalworking industry;
- (b) The establishment of a national repair workshop.

Ghana

- (a) Assistance in the manufacture of simple components for diesel locomotives, railway carriages and other machinery;

- (b) The establishment of a testing laboratory for diesel engine components;
- (c) Fellowship training for the metalworking industry.

Kenya

- (a) The expansion of the Kenyan Metalworking Development Centre.

Lesotho

- (a) Assistance in the development of the metalworking industry;
- (b) Mobile workshops.

United Republic of Tanzania

- (a) The establishment of a training centre for metalworking industries.

14. That UNIDO should commit itself to careful follow-up of the recommendations of the Workshop. The participants expressed their wish to consider follow-up seminars for reviewing the progress made in the implementation of the Workshop's recommendations.

Annex I

LIST OF PAPERS PRESENTED TO THE WORKSHOP

<i>Symbol</i>	<i>Title and author</i>
ID/WG.263/2	Report on metalworking industries in Ghana J. A. K. Baidoo
ID/WG.263/3	Report on metalworking industries in Lesotho B. T. Moila
ID/WG.263/4	A survey report on metalworking industries in Gambia O. N. C. N'Jie
ID/WG.263/5	Engineering industries in Mali N. Traore
ID/WG.263/6	Technical co-operation among the developing countries of Africa in the engineering industries B. Kelani
ID/WG.263/7	Statistics concerning the mining sector and the iron and steel metalworking, mechanical and electrical engineering and building materials industry A. Lamri
ID/WG.263/8	A brief assessment of the iron and steel industry in Ethiopia A. Negash
ID/WG.263/10	Brief survey of the metalworking industries sector in the Republic of the Upper Volta K. I. Yameogo
ID/WG.263/11	Some aspects of the development of the metalworking industry in the African countries and of the USSR technical assistance to developing countries under UNIDO auspices N. N. Krainov
ID/WG.263/12	Main techno-economic requirements of national metalworking industries B. Yanishevsky
ID/WG.263/13	Significance of the metalworking industry for the development of the national economy B. Yanishevsky
ID/WG.263/14	Report on the state of the engineering industries in Chad M. Madlongar
ID/WG.263/15	Metalworking industries in Tanzania S. A. Malai
ID/WG.263/16	The metalworking industry in Kenya I. O. Kenani

Annex II

SYSTEMATIC CLASSIFICATION OF METALWORKING INDUSTRIES

Major group I. Manufacture of metal products (16 branches)

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|---|--|
| <p>A. Tin-can and other tinware manufacture</p> <ol style="list-style-type: none"> 1. Metal cans 2. Milk shipping containers 3. Other tinware <p>B. Hand-tool manufacture</p> <ol style="list-style-type: none"> 1. Wrenches 2. Hammers 3. Screwdrivers 4. Pliers 5. Shovels <p>C. Edged-tools manufacture</p> <ol style="list-style-type: none"> 1. Scythes 2. Adzes 3. Paper-cutting dies 4. Planca 5. Can-openers <p>D. Handsaw and saw-blade manufacture</p> <ol style="list-style-type: none"> 1. Heavy handsaws 2. Hacksaws 3. Carpenters' cross-cut saws 4. Woodworking power-saw blades 5. Metalworking power-saw blades <p>E. Cutlery manufacture</p> <ol style="list-style-type: none"> 1. Knives 2. Knife blades 3. Razors and razor blades 4. Scissors and scissor blades <p>F. Furniture and builders hardware manufacture</p> <ol style="list-style-type: none"> 1. Furniture hardware 2. Door locks 3. Radiators 4. Stoves 5. Window hardware <p>G. Transportation equipment hardware manufacture</p> <ol style="list-style-type: none"> 1. Marine hardware 2. Aircraft hardware 3. Motor vehicle lock units 4. Railway coach | <p>H. Structural and sheet-metal work</p> <ol style="list-style-type: none"> 1. Metal doors and frames 2. Stairs and staircases 3. Store fronts 4. Cornices 5. Ventilators <p>I. Boiler shop manufacture</p> <ol style="list-style-type: none"> 1. Boilers 2. Tanks <ol style="list-style-type: none"> (a) Light tanks (b) Heavy tanks 3. Gas cylinders <p>J. Metal-stamping manufacture</p> <ol style="list-style-type: none"> 1. Spoons 2. Stamped and spun hospital utensils 3. Aviation equipment stampings 4. Agricultural equipment stampings 5. Radio and television stampings <p>K. Metal-fastener manufacture</p> <ol style="list-style-type: none"> 1. Bolts 2. Nuts 3. Rivets 4. Screws <p>L. Lighting-fixture manufacture</p> <ol style="list-style-type: none"> 1. Incandescent lighting fixtures 2. Incandescent portable lamps 3. Motor vehicle headlights 4. Flashlights 5. Airway lighting fixtures 6. Kerosene and gasolene lamps <p>M. Steel, nail and spike manufacture</p> <ol style="list-style-type: none"> 1. Steel-wire nails 2. Steel-wire spikes 3. Steel-cut nails 4. Steel-cut spikes <p>N. Wire manufacture</p> <ol style="list-style-type: none"> 1. Non-insulated wire cables 2. Upholstery wire springs 3. Precision mechanical springs 4. Composite cables |
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| <p>O. Steel-spring manufacture</p> <ol style="list-style-type: none"> 1. Helical automobile springs 2. Helical locomotive and railway-car springs 3. Leaf automotive springs 4. Leaf tractor springs 5. Leaf locomotive and railway car | <p>P. Safe and vault manufacture</p> <ol style="list-style-type: none"> 1. Fire-resistant safes 2. Burglary-resistant safes 3. Safe-deposit boxes 4. Bank security vaults |
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Major group II. Machine tool industry (12 branches)

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| <p>A. Boring and drilling machine industry</p> <ol style="list-style-type: none"> 1. Horizontal machines 2. Vertical boring machines 3. Precision boring machines 4. Vertical drilling machines 5. Radial drilling machines 6. Multiple spindle drilling machines <p>B. Gear-cutting and finishing machine industry</p> <ol style="list-style-type: none"> 1. Gear-hobbing machines 2. Gear cutters 3. Gear-lapping machines 4. Gear tooth-grinding machines 5. Gear-boring machines <p>C. Grinding and polishing machine industry</p> <ol style="list-style-type: none"> 1. External cylindrical grinding machines 2. Internal cylindrical grinding machines 3. Surface-grinding machines 4. Boring machines 5. Lapping machines <p>D. Lathe industry (except wood-working lathes)</p> <ol style="list-style-type: none"> 1. Bench lathes 2. Engine lathes (swing dimensions) 3. Automatic between centre lathes 4. Automatic screw machines 5. Turret lathes <p>E. Special machine-tool industry</p> <ol style="list-style-type: none"> 1. Bench and hand-milling machines 2. Bed-type milling machines 3. Centering machines 4. Shapers 5. Sawing machines <p>F. Metalworking press and forging press industry</p> <ol style="list-style-type: none"> 1. Mechanical inclinable presses | <ol style="list-style-type: none"> 2. Mechanical end-wheel presses 3. Mechanical vertical arch-frame presses <ol style="list-style-type: none"> (a) 500 tons and under (b) 501 tons and over 4. High-speed automatic presses 5. Hydraulic and pneumatic presses <ol style="list-style-type: none"> (a) 500 tons and under (b) 501 tons and over 6. Manual presses <p>G. Forging and machine industry</p> <ol style="list-style-type: none"> 1. Steam and air hammers 2. Mechanical hammers 3. Headers and upsetters 4. Swaging machines 5. Bulldozers <p>H. Shearing, bending and forming machine industry</p> <ol style="list-style-type: none"> 1. Manually driven shearing machines 2. Power-driven shearing machines 3. Manually driven bending and forming machines 4. Power-driven forming and shearing machines 5. Welding and cutting acetylene apparatus <p>I. Power-driven hand tool industry</p> <ol style="list-style-type: none"> 1. Electric drills 2. Electric hammers 3. Electric saws 4. Pneumatic drills 5. Pneumatic hammers 6. Pneumatic saws <p>J. Cutting tool, die and jig industry</p> <ol style="list-style-type: none"> 1. Broaches 2. Drills 3. Reamers 4. Gear cutters 5. Special dies and jigs |
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K. Precision-measuring tool industry

1. Micrometers
2. Gauges
3. Calipers
4. Dial indicators
5. Comparators

L. Woodworking machinery industry

1. Sawmill equipment
2. Lathes
3. Planing machines
4. Surfacing machines
5. Sawing machines

*Major group III. Power engine and general industrial machinery (5 branches)***A. Steam engine and turbine industry**

1. Steam engines
2. Steam turbines
3. Hydraulic turbines
4. Steam turbine generator sets

B. Internal combustion engine industry

1. Gasolene engines
2. Diesel engines
3. Liquified petroleum (LP) gas engines

C. Nuclear reactor industry

1. Power reactors
 - (a) Thermal reactors
 - (b) Intermediate reactors
 - (c) Fast reactors

2. Research reactors

3. Cooling systems
4. Control systems

D. Pump and compressor industry

1. Pumps
2. Air compressors
3. Gas compressors
4. Blowers and fans

E. Bearing industry

1. Ball bearings
2. Roller bearings
3. Mounted bearings
 - (a) Ball
 - (b) Roller

*Major group IV. Transportation equipment industry (10 branches)***A. Passenger automobile industry**

1. Passenger automobiles
2. Engines
3. Carburettors
4. Pistons

B. Truck, lorries and bus industry

1. Lorries
2. Truck trailers
3. Automobile trailers
4. Buses

C. Aircraft industry

1. Aircraft
 - (a) Commercial type
 - (b) Sport type
 - (c) Military type
2. Aircraft engines
3. Aircraft propellers

D. Shipbuilding and ship-repairing

1. Building non-propelled ships
2. Building self-propelled ships
 - (a) Other than military
 - (b) Military

3. Ship repair

E. Boat building and repair

1. Boat building
 - (a) Non-military
 - (b) Military
2. Boat repair
 - (a) Non-military
 - (b) Military

F. Locomotive industry

1. Steam locomotive
2. Diesel electric locomotives
3. Industrial locomotives
 - (a) Diesel electric type
 - (b) Electric type
4. Mining locomotives
5. Locomotive tenders

G. Railway equipment industry

1. Passenger cars
 - (a) Coach
 - (b) Sleeping
 - (c) Dining

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| <ul style="list-style-type: none"> 2. Freight cars <ul style="list-style-type: none"> (a) Box (b) Flat (c) Tank (d) Refrigerator | <ul style="list-style-type: none"> I. Motor cycle and bicycle industry <ul style="list-style-type: none"> 1. Motor cycles 2. Motor scooters 3. Motor bikes 4. Bicycles |
| <ul style="list-style-type: none"> H. City transport industry <ul style="list-style-type: none"> 1. Street railway cars 2. Trolley buses 3. Subway cars | <ul style="list-style-type: none"> J. Lift and conveyor industry <ul style="list-style-type: none"> 1. Lifts 2. Escalators 3. Conveyors |

Major group V. Farm machinery equipment industry (3 branches)

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| <ul style="list-style-type: none"> A. Tractors <ul style="list-style-type: none"> 1. Wheeled tractors 2. Garden tractors 3. Track-laying tractors B. Soil-preparing and cultivating farm machinery <ul style="list-style-type: none"> 1. Ploughs 2. Barrows 3. Rollers 4. Corn planters | <ul style="list-style-type: none"> 5. Broadcast seeders 6. Sprayers and dusters C. Harvesting and dairy machinery <ul style="list-style-type: none"> 1. Combines <ul style="list-style-type: none"> (a) Pull type (b) Self-propelled 2. Maize harvestors 3. Dairy machines <ul style="list-style-type: none"> (a) Cream separators (b) Other dairy machines |
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Major group VI. Heavy machine building industry (4 branches)

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| <ul style="list-style-type: none"> A. Metallurgical machinery <ul style="list-style-type: none"> 1. Converters 2. Ladles 3. Ingot moulds 4. Casting machines B. Foundry machinery <ul style="list-style-type: none"> 1. Core-making machines 2. Moulding machines 3. Blast-cleaning machines 4. Foundry machines | <ul style="list-style-type: none"> C. Industrial furnace and oven industry <ul style="list-style-type: none"> 1. Electric industrial furnaces <ul style="list-style-type: none"> (a) Metal melting (b) Metal processing 2. Fuel-fired industrial furnaces <ul style="list-style-type: none"> (a) Metal melting (b) Metal processing 3. Industrial ovens <ul style="list-style-type: none"> (a) Electric (b) Infra-red D. Rolling-mill machinery <ul style="list-style-type: none"> 1. Rolling mills 2. Rolling-mill equipment |
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*Major group VII. Construction and mining machinery
(4 branches)*

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| <ul style="list-style-type: none"> A. Construction machinery industry <ul style="list-style-type: none"> 1. Contractors wheeled tractors 2. Cranes 3. Scrapers 4. Graders 5. Road rollers | <ul style="list-style-type: none"> B. Mineral-crushing and sorting machinery industry <ul style="list-style-type: none"> 1. Crushers 2. Grinding machines 3. Mixers 4. Dimension stone-cutting machines |
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| <p>C. Mining machinery industry</p> <ol style="list-style-type: none"> 1. Coal-cutting machines 2. Continuous mining machines 3. Creeper underground loaders | <p>D. Oil-field machinery industry</p> <ol style="list-style-type: none"> 1. Surface drilling machines 2. Subsurface drilling equipment |
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*Major group VIII. Electrical machinery and equipment industry
(12 branches)*

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| <p>A. Motor and generator industry</p> <ol style="list-style-type: none"> 1. Fractional horse-power motors <ol style="list-style-type: none"> (a) Under 0.05 hp (b) 0.05-1 hp 2. Integral horsepower motors/generator <ol style="list-style-type: none"> (a) Single phase (b) Polyphase induction <ol style="list-style-type: none"> 1-50 hp 50-500 hp (c) Synchronous <ol style="list-style-type: none"> 1-50 hp 50-500 hp over 500 hp 3. Gasolene engine-driven generator sets 4. Diesel engine-driven generator sets 5. Wind-driven generator sets <p>B. Transformer industry</p> <ol style="list-style-type: none"> 1. Power and distribution transformers 2. Speciality transformers (under 600 V) 3. Power regulators 4. Boosters 5. Reactors <p>C. Electrical distribution and control apparatus industry</p> <ol style="list-style-type: none"> 1. Distribution switchboards 2. Switches 3. Circuit breakers 4. Power switchboards 5. Relays 6. Fuses and fuse equipment <p>D. Welding machinery industry</p> <ol style="list-style-type: none"> 1. Arc-welding machines 2. Arc-welding electrodes 3. Metal resistance welders 4. Special welding apparatus | <p>E. Electric measuring instrument industry</p> <ol style="list-style-type: none"> 1. Integrating instruments <ol style="list-style-type: none"> (a) Watt/hour meters (b) Demand meters 2. Test equipment <ol style="list-style-type: none"> (a) Oscilloscopes (b) Voltmeters, ohmmeters and millimeters (c) Microwave test equipment (d) Radio frequency measuring equipment <p>F. Electrical appliance industry</p> <ol style="list-style-type: none"> 1. Fans 2. Water heaters 3. Cooling appliances 4. Heating appliances 5. Electric irons 6. Household ranges <p>G. Engine electrical equipment industry</p> <ol style="list-style-type: none"> 1. Ignition harness sets 2. Battery-charging generators for internal combustion engines 3. Cranking motors for internal combustion engines <ol style="list-style-type: none"> (a) Passenger cars and light trucks (b) Heavy trucks and tractors (c) Aircraft engines 4. Condensers <p>H. Electric lamp industry</p> <ol style="list-style-type: none"> 1. Large incandescent lamps 2. Miniature incandescent lamps 3. Electrical discharge lamps <p>I. Radio and television equipment industry</p> <ol style="list-style-type: none"> 1. Home radio receivers 2. Portable radio receivers 3. Photographs 4. Television receivers 5. Radio and television transmitters |
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| <p>J. Electronic tube and transistor industry</p> <ol style="list-style-type: none"> 1. Cathode ray tubes, television picture tubes 2. Transistors 3. Diodes 4. Other electronic elements <p>K. Telephone and telegraph equipment industry</p> <ol style="list-style-type: none"> 1. Telephone sets | <ol style="list-style-type: none"> 2. Telephone switchboards 3. Telegraph apparatus and equipment 4. Radar equipment <p>L. X-ray and therapeutic apparatus industry</p> <ol style="list-style-type: none"> 1. Medical X-ray units 2. Dental X-ray units 3. Industrial X-ray units 4. Ultra violet health lamp fixtures 5. Cardiographs |
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*Major group IX. Chemical processing machinery and equipment industry
(10 branches)*

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| <p>A. Petroleum refinery machinery and equipment industry</p> <ol style="list-style-type: none"> 1. Petroleum pumps 2. Petroleum-refining apparatus 3. Benzene-producing apparatus 4. Benzol-producing apparatus 5. Gas-producing apparatus <p>B. Pulp and paper mill machinery industry</p> <ol style="list-style-type: none"> 1. Pulp mill digesters 2. Pulp mill grinders 3. Pulp mill deckers 4. Paper mill machinery <p>C. Paper machine industry</p> <ol style="list-style-type: none"> 1. Fourdriniers 2. Cylinders 3. Calenders 4. Bag-making machines 5. Box-making machines <p>D. Printing trade machinery industry</p> <ol style="list-style-type: none"> 1. Letterpress machinery 2. Offset lithographic machinery 3. Typesetting machines 4. Electrotyping machines 5. Bookbinding machines <p>E. Plastic-working machinery industry</p> <ol style="list-style-type: none"> 1. Compression-moulding machines 2. Extrusion-moulding machines 3. Injection-moulding machines | <p>F. Rubber-working machinery industry</p> <ol style="list-style-type: none"> 1. Mill-mixing machines 2. Calendering machines 3. Extruding machines 4. Vulcanizing presses 5. Tire-building machines <p>G. Cement making machinery industry</p> <ol style="list-style-type: none"> 1. Natural cement machines 2. Hydraulic cement machines 3. High temperature cement machines 4. Fibro-cement machines <p>H. Glass-making machinery industry</p> <ol style="list-style-type: none"> 1. Bottle machines 2. Laboratory glassware machines 3. Window glass machines 4. Industrial glass machines 5. Electric bulb machines <p>I. Chemical-processing industry</p> <ol style="list-style-type: none"> 1. Distillery apparatus 2. Purifiers 3. Condensers 4. Centrifuges <p>J. Clay-working machinery industry</p> <ol style="list-style-type: none"> 1. Clay-tempering furnaces 2. Clay brick machines 3. Clay tile machines 4. Clay pipe machines 5. Stove-lining machines |
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*Major group X. Food product machinery and equipment industry
(4 branches)*

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| <p>A. Dairy and milk product plant machinery industry</p> <ol style="list-style-type: none"> 1. Bottling machinery 2. Pasteurizers 3. Cheese-making machines 4. Cheese presses 5. Cream separators <p>B. Bakery machinery industry</p> <ol style="list-style-type: none"> 1. Flour mill machinery 2. Grain mill machinery 3. Dough mixers 4. Bake ovens | <p>C. Food-processing machinery industry</p> <ol style="list-style-type: none"> 1. Sugar plant machinery 2. Fruit/vegetable-canning machines 3. Bottling machinery <ol style="list-style-type: none"> (a) Filling-capping machines (b) Bottle washers <p>D. Cigarette and cigar machinery industry</p> <ol style="list-style-type: none"> 1. Cigarette-making machines 2. Cigar-making machines |
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*Major group XI. Textile and shoe-making machinery industry
(3 branches)*

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| <p>A. Textile fibre to fabric machinery industry</p> <ol style="list-style-type: none"> 1. Garnetting machines 2. Picker machines 3. Carding machines 4. Combing machines 5. Spinning and twisting machines 6. Winding machines <p>B. Textile fabric machinery industry</p> <ol style="list-style-type: none"> 1. Power looms | <ol style="list-style-type: none"> 2. Knitting machines 3. Weaving machines 4. Braiding machines <p>C. Shoemaking and repairing machinery industry</p> <ol style="list-style-type: none"> 1. Hide skin and leather-preparing machinery 2. Shoemaking machines 3. Shoe-repairing machines |
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Major group XII. Office and store machine industry (4 branches)

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| <p>A. Computing machine industry</p> <ol style="list-style-type: none"> 1. Adding machines <ol style="list-style-type: none"> (a) Electric (b) Manual 2. Calculating machines 3. Punch card system machines 4. Cash registers <p>B. Typewriter industry</p> <ol style="list-style-type: none"> 1. Electric typewriters 2. Manual typewriters 3. Special and automatic typewriters | <p>C. Electronic data-processing and computer industry</p> <ol style="list-style-type: none"> 1. Analogue computers 2. Analogue computers with added memory 3. Digital computers 4. Electronic data processors <p>D. Scale and balance industry</p> <ol style="list-style-type: none"> 1. Railroad truck and motor truck scales 2. Retail and commercial scales 3. Laboratory precision scales |
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Major group XIII. Household and service machine industry (6 branches)

- A. Household washing-machine industry
 - 1. Fully automatic washing machines
 - 2. Semi-automatic washing machines
 - 3. Non-automatic washing machines
 - 4. Driers
 - 5. Ironers
- B. Laundry and dry-cleaning machine industry
 - 1. Washers
 - 2. Extractors
 - 3. Drying tumblers
 - 4. Laundry presses
 - 5. Dry-cleaning presses
- C. Sewing machine industry
 - 1. Household sewing machines
 - 2. Industrial sewing machines
- D. Vacuum cleaners and other household equipment industry
 - 1. Household vacuum cleaners
 - 2. Industrial vacuum cleaners
 - 3. Other household cleaning equipment
- E. Refrigeration machinery industry
 - 1. Household refrigerators
 - (a) Gas
 - (b) Electric
 - 2. Home and farm freezers
 - 3. Industrial and commercial refrigerators and freezers
- F. Clock and watch industry
 - 1. Electric clocks
 - 2. Spring-wound clocks
 - 3. Men's wrist-watches
 - 4. Women's wrist-watches
 - 5. Pocket watches

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