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Meeting of Experts/Decision Makers for Promotion and Development of Machine Tool Industries in Developing Countries of Asia and the Far East

Tbilisi, Georgia, USSR, 5 - 15 October 1974

SOME ASPECTS OF THE DEVELOPMENT OF MACHINE TOOL INDUSTRIES IN THE COUNTRIES OF THE ECAFE REGION 1/

prepared by

the Secretariat of UNIDO

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INTRODUCTION

The United Nations Industrial Development Organization (UNIDO) was established in 1967, as an autonomous organization within the Secretariat of the United Nations. The main purpose of the Organization is to promote and accelerate the process of industrialization in the developing countries.

The principal legislative body of UNIDO is the Industrial Development Board which meets once a year. The executive organ is the UNIDO Secretariat with its headquarters in Vienna, Austria.

UNIDO's operations cover a very wide field of activity connected with technical assistance to developing countries in the planning and programming of their industrial development including, inter alia, the formulation and implementation of industrial policies; the development of certain branches of industry; the establishment of research institutes and centres of industrial development; the training of local personnel; and the creation of pilot industrial plants.

The main sources of finance for the provision of technical assistance to developing countries are the United Nations Development Programme Indicative Planning Figure, by country and intercountry (IPF), and the Special Industrial Services Programme (SIS), in addition to the United Nations Regular Programme and the General Trust Fund (GTF) of UNIDO.

One of the activities of UNIDO is to promote the development of metal-working industries in the countries of the "third world" and particularly the proper selection and utilization, design and development, maintenance and repair of machine tools and their accessories, in these countries.

The United Nations Interregional Symposium on the Development of Metalworking Industries in Developing Countries, held in Moscow in 1966, dealt with general problems of metalworking industries in Asia, Africa and Latin America and drew attention to the different levels of development in these regions. It was recommended to examine in greater detail the situation in the metalworking industries, and, particularly, the machine tod industry in the countries of these regions. That is why the idea came to examine their metalworking industries and the status of their machine tools region by region.

In 1971, the UNIDO Regional Seminar on Machine Tools for the Countries of Europe and the Middle East was held in Bulgaria in co-operation with the Economic Commission for Europe (ECE). It was the unanimous agreement, that the Seminar was useful both for developing and developed countries as many direct contacts were established that lead to mutually beneficial commercial and technical arrangements. In accordance with the recommendations of the Seminar, UNIDO technical assistance has been provided to ten countries of the Region, including Bulgaria; Egypt, Arab Republic of; Hungary; Iran; Israel, Jordan, Kuwait, Turkey; Yemen Arab Republic; and Yemen, People's Democratic Republic of.

In 1972, in co-operation with the Economic Commission for Latin America (ECLA), UNIDO held the Seminar on Machine Tools for Countries of Latin America, in Argentina and Brazil. The Seminar gave an analysis of the present status of machine tools and identified their demand in accordance with the future development of metalworking industries in the countries of the Region. The recommendations were made on selection, utilization, maintenance and repair of machine tools, problems of their design, manufacture, quality control and testing. The problems of the introduction of numerically controlled machine tools into the industry of the countries of the Region were considered as well. During the course of the Seminar, 37 projects were identified under the Investment Promotion Programme and necessary contacts were established between interested parties. UNIDO technical assistance has also been identified for ten countries of the region - namely, Argentina, Bolivia, Brazil, Colombia, Ecuador, Mexico, Paraguay, Peru, Uruguay, and Venezuela. Some projects have already been implemented, some of them are under implementation.

The Consultative Meeting on the Promotion of the Metalworking Industries in Africa, to be held in 1975, will be the fourth Meeting of this nature and would follow the two above mentioned Seminars and the Meeting of Experts/ Decision Makers for Promotion and Development of Machine Tool Industries in Developing Countries of Asia and the Far East, to be held in Tbilisi, Georgia, USSR, from 5 to 15 October 1974.

The author of the paper, Mr. N.N. Krainov, Engineering Industries Section, Industrial Technology Division, UNIDO, has described the problems confronting the developing countries of the region in the promotion of their metalworking industries and the role of UNIDO in providing them with technical assistance in this field. He participated in the Seminar in Bulgaria in 1971 and in Argentina and Brazil in 1972, and tried to use the previous experience in the preparation of this paper.

PART I

MACHINE TOOL PRODUCTION AND TRADE

1. Role of Machine Tool Building and Tool-Making Industries in the Industrialization of the Countries of the "Third World"

The developing countries of the ECAFE region in common with other developing countries, encounter difficulties in their economic development which depends mainly on their industrial development.

The task of selecting the particular branch of the economy that should be given first priority has to be studied in the light of the capacities and resources of the individual country.

The industrial structure of developing countries is contingent upon their natural resources and inherent characteristics. Some of them promote industries aimed at the production of electricity by the creation of electric power stations, others develop their metallurgical and mining industries or cement and petrochemical industries, while some countries concentrate on automotive and engineering industries. As agriculture is the predominant feature of the economies of many developing countries they try to promote such industries as food processing and textiles.

As industries of any description require machinery and equipment for normal operation, the first consideration is the provision of machine tools and accessories needed for the production of the equipment.

During the initial period of industrial development these requirements can be met by imports. With the growth of industry, however, it becomes unprofitable for developing countries to import machinery owing to the considerable disparity in the cost of imported machinery and the price of the agricultural products and raw materials that are exported. Hence, many developing countries are now paying much attention to the development of the metalworking industry where machine tools are a vital factor.

The metalworking industry, probably more than any other industry, requires the constant application of the latest developments of science and technology in order to solve a number of problems connected with the utilization of new types of metalcutting and metalforming machines essential for modern technological production.

However, it is not enough that the people of a country only wish to create machine-tool building industries. The countries must have certain

prerequisites for the creation of these industries, including design and production capabilities, skilled labour, ancillary industries for castings, forgings, bearings, electrical equipment, components and tools. As a first step in this direction, they should develop their metalworking industries.

The industrial progress of most developing countries, especially in the engineering industry, is seriously hampered by the lack of indigenous production of tools, dies, jigs and fixtures, including dies for press-work, dies and moulds for forgings, dies and moulds for diecasting, dies and moulds for plastic moulding.

Many of the developing countries have to buy the jigs, fixtures, dies and moulds needed for production from abroad. Others have to import the appropriate grades of steel for the manufacture of these tools. Such purchases require foreign currency which is usually in short supply in developing countries. Apart from the financial disadvantages accruing from the purchasing abroad of these items, serious delays may result which cause further expenditure owing to the disruption of manufacturing programmes. In addition to such tangible disadvantages, there are many intangible problems that are difficult to define. They may occur owing to a lack of understanding of the design of the tooling with a consequent failure to use the most suitable methods of manufacture, this, in turn, results in an insufficient utilization of extremely expensive presses and forging machines and the subsequent expenditure on secondary operations which otherwise would be unnecessary or could be undertaken more economically.

The manufacture of jigs, fixtures, dies and moulds is a labour intensive operation which makes it particularly desirable that this activity should be undertaken locally, rather than importing these items from an industrialised country where the labour rates are much higher.

The production of jigs, fixtures, dies and moulds is a specialised operation requiring a highly skilled team of management and labour. The enterprises producing such items can benefit considerably from a proximity to the principal customers of these goods, who in turn can improve efficiency by an understanding of the design problems and manufacturing techniques involved.

2. World Machine Tool Production and Trade

There is a continuously growing demand everywhere for metal-cutting and metal-forming machine tools that are indispensable for the production and repair of the various machines that are rapidly being introduced into all branches

of industry. The machine tool is the only product that is capable of reproducing itself. For this reason, machine tools play a key role in the expansion of industrial production since nearly all products are manufactured by metalworking machines. The machine tool is never an end product, per se, but it is a means of manufacturing the end product.

The world machine tool production in 1972, represents US$8,400.0 million, according to prices prevailing in 1972. Table 1 on page 8 shows nearly all the countries that manufacture machine tools, and their percentage of world production with figures of their own production in 1970 and 1972.

The estimated world production of machine tools in 1973, in accordance with the American Machinist (21 January 1974) was US$10.6 milliards, i.e., an increase of 25% above the US$8.4 milliards in 1972. This large increase, however, is due partly to the shrinking value of the dollar in which the figures are recorded.

Production of metal cutting machines expanded a little more than did the output of metal forming machines. Metal cutting machines amounted to 73.4% of the total in 1973 versus 71.3% in 1972.

The machine tool production and trade estimated in 1973 for the main manufacturing countries is shown in Table 2 on page 9 in millions of US dollars at the average rate for commercial transactions during 1973.

From Table 2 it can be seen that in 1973 four countries are leading machine tool manufacturing nations - namely, FRG (US$2.1 milliards), USSR (US$1.7 milliards), USA (US$1.6 milliards) and Japan (US$1.4 milliards). The production of these four countries amounts to 64% of the world machine tool production.

The FRG is the biggest producer, with 20% of the world production, and is also the biggest exporter, with 35% of the total export volume..

The USSR is the second producer of machine tools in the world, manufacturing 210,000 machine tools in 1972 and 213,000 units in 1973. It is expected that the USSR will produce 250,000 units in 1975. The Soviet Union also increased the production of NC machine tools. For the first 10 months of 1973, NC machine tool output was 3,068 units, an increase of 25% over the first 10 months of 1972.

TABLE 1*/

World Machine Tool Production

No.	Country	1970 in millions of US$ TOTAL	Metal Cutting	Metal Forming	Percentage of world production	1972 in millions of US$ TOTAL	Metal Cutting	Metal Forming	Percentage of world production
1	FRG	1479.0	1018.4	460.6	18.9	1790.6	1178.6	612.0	21.3
2	USSR	1073.0	803.0	270.0	13.7	1390.1	1029.2	360.9	16.5
3	USA	1443.1	992.9	450.2	18.5	1169.0	801.8	367.2	13.9
4	Japan	1109.4	867.4	242.0	14.2	876.6	666.2	210.4	10.4
5	Italy	433.6	346.9	86.7	5.6	430.0	344.0	86.0	5.1
6	UK	476.9	378.5	98.4	6.2	424.4	282.9	141.5	5.1
7	France	316.5	240.5	76.0	4.1	408.0	306.0	102.0	4.9
8	GDR	252.3	185.7	66.6	3.3	331.5	244.4	87.1	3.9
9	Switzerland	242.0	206.0	36.0	3.1	252.6 1/	214.7 1/	37.9 1/	3.0
10	Czechoslovakia	250.0	210.0	40.0	3.2	250.0 1/	205.0 1/	45.0 1/	3.0
11	Poland	123.0	112.0	11.0	1.6	234.2	217.9	16.3	2.8
12	Spain	88.6	77.5	11.1	1.0	133.9	112.4	21.5	1.6
13	Sweden	66.0	43.0	23.0	0.8	82.5 2/	57.7 2/	24.8 2/	1.0
14	China	66.2	38.9	28.3	0.8	82.0 2/	62.0 2/	20.0 2/	1.0
15	Yugoslavia	26.0	22.5	3.5	0.3	69.6	55.0	14.6	0.8
16	Hungary	44.7	41.6	3.1	0.5	57.9	54.9	3.4	0.7
17	India	31.2	29.3	1.9	0.4	55.3	48.3	7.0	0.7
18	Belgium	33.9	16.3	17.6	0.4	53.8	20.1	33.7	0.6
19	Brasil	33.8	19.6	14.2	0.4	46.4 1/	31.3 1/	15.1 1/	0.6
20	Argentina	32.4	19.0	14.4	0.4	41.1 1/	22.9 1/	18.2 1/	0.5
21	Austria	25.4	11.6	13.8	0.3	40.7	27.0	13.7	0.5
22	Canada	34.9	21.1	13.8	0.4	40.5 3/	23.5 3/	17.0 3/	0.5
23	Australia	22.5	6.2	16.3	0.3	33.0 3/	15.7 3/	17.3 3/	0.4
24	Netherlands	29.7	18.5	11.2	0.4	26.5	17.1	9.4	0.3
25	Bulgaria	23.0	21.0	2.0	0.3	26.4 2/	24.1 2/	2.3 2/	0.3
26	Romania	17.0	15.5	1.5	0.2	19.0 2/	18.0 2/	1.0 2/	0.2
27	Denmark	14.7	9.1	5.6	0.2	18.4 1/	8.7 1/	9.7 1/	0.2
28	South Africa	7.2	3.3	3.9		9.6 1/	3.7 1/	5.9 1/	0.1
29	Mexico	5.0	2.0	3.0		5.0 2/	4.5 2/	0.5 2/	0.03
30	Turkey	4.9	2.9	2.0					
31	Portugal	2.8	1.5	1.3		4.1 1/	2.6 1/	1.5 1/	0.04
32	Egypt	1.7	0.7	1.0	0.5				
33	Israel	1.3	1.0	0.3		2.3	1.7	0.6	0.03
34	Chile	0.9	0.5	0.4					
35	Other countries								
	TOTAL	7813.6	5782.6	2031.0	100	[illegible]	6101.2	930.6	100

*/ American Machinist, January 21, 1974
Machine Tool in Countries of Latin America, ID/WG.113/ Corr.1 by N.N. Krainov

1/ Estimated

2/ Rough estimate from fragmentary data

3/ Year ended June 30

TABLE 2*/

Estimated World Machine Production and Trade in 1973

in millions of US$

No.	Country	PRODUCTION			TRADE	
		Total	Cutting	Forming	Export	Import
1	FRG	2,118.7	1,416.3	702.4	1,346.3	213.8
2	Soviet Union	1,698.0	1,260.0	438.0	142.0	478.0
3	United States	1,610.0	1,135.0	475.0	325.0	165.0
4	Japan	1,408.0	1,102.9	305.1	202.2	106.6
5	Italy	544.0	435.2	108.8	212.5	170.0
6	United Kingdom	504.0	340.8	163.2	210.5	153.8
7	France	475.8	344.2	131.6	178.9	263.2
8	GDR	454.7	339.6	115.1	349.1	79.2
9	Switzerland	315.2	267.9	47.3	247.6	92.1
10	Poland	270.7	252.5	18.2	90.5	232.2
11	Czechoslovakia	255.0	208.0	47.0	140.0	70.0
12	Spain	146.1	122.0	24.1	91.3	47.0
13	Sweden	99.8	69.7	30.1	76.7	73.9
14	Yugoslavia	86.0	68.0	18.0	18.0	66.0
15	China	85.7	64.5	21.2	9.0	89.0
16	Belgium	61.9	23.0	38.9	52.6	59.8
17	Hungary	58.5	54.5	4.0	34.0	28.0
18	India	55.3	48.3	7.0	3.5	25.0
19	Brazil	55.0	36.8	18.2	5.1	61.5
20	Austria	52.7	35.5	17.2	43.3	61.6
21	Canada	45.7	26.7	19.0	35.0	126.0
22	Australia	45.0	21.5	23.5	6.7	44.8
23	Argentina	40.0	22.0	18.0	4.0	20.0
24	Netherlands	28.7	18.5	10.2	33.2	55.6
25	Bulgaria	27.3	25.0	2.3	17.5	35.0
26	Rumania	20.0	19.0	1.0	5.0	30.0
27	Denmark	21.7	10.2	11.5	22.2	20.6
28	South Africa	10.0	4.0	6.0	0.4	32.0
29	Mexico	5.5	5.0	0.5	-	77.0
30	Portugal	4.5	3.0	1.5	2.5	15.0
31	Israel	2.8 1/	2.1	0.6	n/a	n/a
	TOTAL	10,606.3	7,781.7	2,824.5	3,890.6	2,992.7

*/ American Machinist 21 January 1974

1/ Production of machine tools in Israel in 1974 is expected to be US$3.2 million, including US$2.5 million of metalcutting machines and US$0.7 million of metal-working

The Soviet Union remains the greatest consumer of machine tools (in 1973 it installed more that US$2 milliards of machine tools, 40% more than did the second ranking USA with US$1.4 milliards) and the biggest importer (US$478 million). In order to increase the production of machine tools, the USSR is constructing new plants by itself and in co-operation with other countries. Thus, Gildemeister (FRG) is currently involved in negotiations for two turnkey machine tool plants that would involve hundreds of millions of dollars. One plant will produce single spindle automatic lathes at the rate of 2,000 a year, while the other one will be for NC lathes.

The USA is the third ranking machine tool manufacturing country in the world, the share of which in 1972 was 13.9%. The production has been increased by 37% in 1973 in comparison with 1972. It is expected that in 1974 there will be an increase of about 20%.

Japan recovered rapidly from the recession of 1971 and 1972, because the consumption and exports of machine tools steadily increased again. Japan is the third leading country in the world after the USSR and the USA in the consumption of machine tools. In 1972 the Japanese consumption was US$835.2 millions, while in 1973 it rose to US$1.3 milliards.

3. Share of the Region in Machine Tool Production and Trade

In spite of the fact that more and more developing countries of Africa, Asia and Latin America have started to produce machine tools, their share in the world machine tool production is still rather low, for instance in 1972 it was about 3%.

The share of the developing countries of the ECAFE region in 1972 was 1.8% of the world production.

The countries of this region, which manufacture machine tools, including the USSR and Japan produced 28,7% of the worlds machine tools in volume.

It is difficult to show the machine tool production in the developing countries of the region, because many of them have no statistical data on their production. It is estimated that the value of the machine tool production in the countries of the region in 1972 was US$2,414 milliards.

The import of machine tools by the regions is shown in Table 3 in millions of US$, starting from 1966 to 1972.

The production of machine tools in the countries of the ECAFE region in 1972 is shown below:

COUNTRY	Machine Tool Production in millions of US$	Percentage of the Regional Machine Tool Production	Percentage of World Machine Tool Production
USSR	1,390.1	57.6%	16.5%
Japan	876.6	36.3%	10.4%
China	82.0	3.4%	1.0%
India	55.3	2.3%	0.7%
Other countries	10.0	0.4%	0.1%
TOTAL: ECAFE Region	2,414.0	100.0%	28.7%
TOTAL: World	8,405.0		100.0%

On table 3 it can be seen that the countries of the ECAFE Region import more machine tools than those of other regions.

In 1972 the import of machine tools in this region was US$715.4 million, while in Latin America it was US$198.0 million, Africa US$84.4 million and the Middle East US$40.8 million.

The import of machine tools by the countries of the ECAFE region in 1972 is shown on Table 4. From Table 4 it can be seen that the percentage of the region in the world machine tool production in 1972 was 24.3%. The main importers of machine tools are the USSR, Japan, China and India.

Table 3*/

Import of Machine Tools by the Countries of ECAFE Region and other Regions

(1966-1972)

(in million US$ f.o.b.)

REGIONS	1966	1967	1968	1969	1970	1971	1972
Asia and the Far East including USSR	305.5 (122.2)	343.2 (136.5)	432.8 (161.2)	614.7 (336.7)	625.6 (310.3)	621.4 (282.7)	715.4 (463.9)
Latin America	87.8	104.0	121.6	123.5	133.9	157.2	198.0
Africa	50.9	52.5	55.7	54.7	73.1	84.6	84.4
Middle East	14.1	17.2	22.6	32.0	40.8	44.9	40.8
TOTAL	458.3	517.0	632.7	824.9	873.4	918.1	1,038.6
TOTAL World	1,879.8	1,714.7	1,754.6	2,133.4	2,473.7	2,866.5	2,943.3

*/ The table is prepared on the basis of information obtained from the Bulletins of Statistics on World Trade in Engineering Products - 1966, 1967, 1968, 1969, 1970, 1971, 1972, Economic Commission for Europe, United Nations, New York

TABLE 4*/

Import of Machine Tools by the Countries of the ECAFE Region in 1972

Country	Import of Machine Tools in millions of US$ f.o.b.	Percentage in the Regional Machine Tool Imports	Percentage in the World Machine Tool Imports
USSR	463.9	64.8	15.8
Japan	85.6	12.0	2.9
China	48.3	6.8	1.6
India	37.6	5.3	1.3
Korea, Republic of	18.3	2.6	0.6
Singapore	12.1	1.7	0.4
Philippines	6.3	0.8	0.2
Malaysia	5.9	0.8	0.2
Thailand	5.7	0.8	0.2
Indonesia	5.4	0.8	0.2
Hong Kong	3.8	0.5	0.1
Korea, Dem. P.P. Rep.	3.3	0.5	0.1
Pakistan	3.0	0.4	0.1
Viet Nam, Dem. Rep.	1.6	0.2	0.05
Viet Nam, Rep. of	0.9	0.1	0.04
Sri Lanka	0.5	0.08	0.02
Burma	0.4	0.06	0.01
Mongolia	0.2	0.03	0.007
Afghanistan	0.2	0.03	0.007
Other Countries	12.3	1.7	0.472
Total ECAFE Region	715.4	100%	24.3
Total World	2,943.3		100%

*/ Bulletin of Statistics on World Trade in Engineering Products - 1972, Economic Commission for Europe, E/F/R 74.II.E.5, United Nations, New York, 1974

PART II

SOME PROBLEMS IN METALWORKING INDUSTRIES IN THE COUNTRIES OF "THE THIRD WORLD"

1. Proper Selection, Application and Utilization of Machine Tools

There is no doubt that for the successful development of metalworking industries the countries of the "third world" should have a large enough quantity of metal cutting and metal forming machine tools, regardless if they are manufactured in these countries or imported from other countries.

In spite of the fact that there has been an increase during the last few years in the quantity of machine tools, the machine tool park in developing countries is still very small in comparison with the industrialized countries. In 1970 more than 60 developing countries in Africa, Asia and Latin America - including such countries as India, Brazil, Argentina and Mexico - had only 10% of the world machine tool park. The remaining 90% of the world park was in 25 industrialized countries. The experience of the last years has shown that in most of the developing countries the success of the industrial development depends not only on the stock of machine tools, but also on the way in which these are used. Some developing countries have sufficient stocks of equipment which are not being fully and properly utilized. This means unnecessary additional expenditure for buying, servicing, repair and maintenance of machine tools.

An analysis of the metalworking industries of developing countries shows that in many of these countries the underutilization of machine tools is about 50%. The main reasons for their underutilization are technological, economic and organizational factors.

The technological reasons include untimely breakage and wearing out of tools, some parts and units of machines; improper selection of cutting feeds and speeds; consequences of technological operations; etc.

The main economic reasons influencing the underutilization of machine tools in these countries are - limited internal market for engineering products produced with these machines; lack of raw materials and foreign currency; shortage of qualified labour; and other related factors.

Among the organizational reasons it is necessary to note the lack of planning, lack of organization and management of many industrial enterprises, working in one shift only, etc.

The machine tool is a means of production that can be expected to sustain a long period of service, so that the selection of the most suitable machine is important to ensure efficiency over a period of years. The machine tool should be selected carefully by those equipped with a knowledge of the methods used in the manufacture of the particular component. The selection of the cheapest machine may prove to be false economy if it has been designed for intermittant operations or for light breakdowns, which may become frequent owing to overloading if the machine is subject to normal workshop use.

2. Maintenance and repair of Machine Tools

In creating a stock of machine tools, developing countries should always plan how to use them most efficiently and how to extend their lifetime as long as possible. This can be achieved only through the organization of a special repair and maintenance system which is particularly important for modern and highly complicated machines that include precision devices, hydraulic and electronic systems, high-speed and power transmission systems, automatic and control devices.

The efficient functioning of a machine tool unit depends to a considerable extent on the methods used to operate, maintain and service it, otherwise much wastage can result, particularly, with regard to foreign exchange for imported material.

Two factors cause wastage when individual units are taken out of service prematurely.

First, there is an increase in the amount of and, consequently the cost of, repair work. Often the repairs entail importing spare parts. When the failure occurs in a complicated precision part, such as a precision lead screw, the bushing of a jig borer, a reading mechanism or the like, it is not always possible to repair and recondition it locally. Such a breakdown can be avoided by proper methods of operation and servicing.

Second, wear and breakdowns increase the time lost in repair and reduce the usefulness of the machine tool in question. Consequently extra machine tools have to be acquired to do the same amount of work, and shop space has to be increased correspondingly.

Furthermore, improperly repaired and maintained machine tools may fail to meet their technical specifications, particularly with regard to accuracy.

One of the important points in maintenance and repair of systems is to determine the time intervals for maintenance and repair of machine tools, taking into account the number of hours of work of these machines and their loading. The precision of the machine tools can be taken as a main factor in determining the time for their maintenance and repair. Preventive maintenance is very important for the long life of machines and includes such activities as regular lubrication, cleaning, resharpening, etc.

3. Machine Tool Rebuilding

The cost of rebuilding an old machine is usually under two thirds of the cost of a new one. If the rebuilding is carried out efficiently, the accuracy and characteristics of the machine will be as good as those of a new one. An enterprise specialising in rebuilding machine tools has the advantage of knowing which parts will normally have to be replaced so that they can be built in stock. As machine tool rebuilding is a less complicated operation than the manufacture of machine tools, there is good reason to establish a rebuilding enterprise in a country before undertaking the manufacture of machine tools.

Two of the more common methods of rebuilding worn-out parts are metal spraying and welding. In many cases, such as sliding surfaces and shafts which become worn or damaged, parts can be resurfaced, and after the appropriate machinery or grinding, they can be rehabilitated, sometimes even giving the same long service as the original parts.

4. Machine Tool Production

The production of machine tools is one of the most attractive industries for any country to develop, because it occupies a central place in the interrelationships between different branches of production and it is of paramount importance for the development of engineering industries.

However, a country existing to start the production of machine tools should have certain pre-requisites such as metalworking industries with skilled labour, ancillary industries for castings, forgings, bearings, electrical equipment and components and tools.

After a study of the preliminary conditions has been carried out, it is necessary to determine the types and sizes of machine tools that should be produced and the quantity.

During the initial stages, it is advisable to produce universal machines, designed to perform a wide range of operations. The types and sizes usually in the greatest demand in developing countries are the following:

- lathes for maximum workpiece diameters of 250 mm, 320 mm, 400 mm and 500 mm;
- steel drilling machines of maximum drilling diameters of 18 mm, 25 mm, 35 mm and 50 mm;
- boring machines with spindle diameters of 65 mm and 80 mm;
- shaping machines with ram strokes of 320 mm, 500 mm and 700 mm;
- knee-type milling machines with a table width of 200 mm, 250 mm and 320 mm;
- circular grinding machines for a maximum workpiece diameter of 140 mm, 200 mm and 280 mm;
- surface grinding machines with a table width of 200 mm and 320 mm;
- universal tool-grinding machines, hack and circular saws.

It does not mean that these types and sizes of universal machines should all be produced at the same time. Manufacture should be carried out according to priority.

It may also be advisable to produce other types and sizes of universal machines, such as small bench-type lathes, milling, drilling and tool-grinding machines, to meet the needs of the handicraft industry.

Although general-purpose machines can perform a wide range of operations, it might be advisable to produce also single-purpose machines which are easy to handle and comparatively inexpensive.

The development of metalworking machine tool production should be integrated with the other industries being developed in a country, as ultimately it is the user industry that determines the type, size and quantity of the machine tools produced.

5. Development of Engineering Design Capabilities

Successful industrial growth depends to a considerable extent upon the indigenous capacity to create and develop engineering and industrial design, as well as to the ability to adapt the designs of products to be manufactured under licensing agreements in accordance with domestic needs. The engineering and industrial design capabilities of nearly all developing countries are either absent or at early stages of development.

In many of the developed nations, the introduction of engineering design began at a late stage of industrialization, because more attention was given at that time to problems of basic manufacture. Only later did these countries understand the importance of design activities.

The developing countries can benefit from the experience of the industrialized nations by improving their indigenous design facilities simultaneously with their manufacturing process, thereby reducing the time lag in their growth to full industrial capacity.1/

The lack of qualified designers hampers the adaptation of modern technology provided by the industrialized nations to these countries.

6. Labour Required

There is no doubt that in order to accelerate the industrialisation in the developing countries, the developed nations should transfer modern technology to these countries, taking into account their habits and local conditions.

However, the modern techniques and technology will not be useful and even can be an additional burden for them if these countries do not have local staff who can accept and adopt these techniques properly.

The proper operation of machine tools and their accessories by the developing countries becomes only possible if there is highly trained personnel available. They need personnel who are not only able to read, but also to understand and interpret the most complicated blueprints, in order to make use of the most complicated means of dimensional and quality control with tolerances expressing in fractions of millimeter. They must also be qulaified to adjust at any given moment any deviation from the required tolerances in the operation of machine tools serviced by them.

Today developing countries of the ECAFE region can obtain the tools that are necessary for the most complicated manufacturing processes. They can hire the necessary personnel, highly skilled management, as well as skilled foremen in the case of lack in the local labour market. However, skilled labour cannot normally, or not in sufficient numbers, be hired from foreign countries and to a large extent, would have to be trained locally.

1/ Mr. N.N. Krainov's statement at the Expert Group Meeting on the Development of Engineering Design Capabilities in Developing Countries, ID/67, United Nations, New York, 1972

The number of scientists involved in research activities in the developing countries is very limited.

In 1965, for instance, Japan had 1.5 times more scientists involved in research activities than all the developing countries, that is 144,000 against 91,200 scientists in developing countries.

The industrial enterprises of many developing countries do not have any research, engineering, technical and design facilities, which are urgently required in order to improve the situation in their metalworking industries.

The developing countries are lagging behind in research, and they are trying to balance this by expanding the import of metalworking machinery and equipment. From 1966 to 1972 the import of metalworking machinery and machine tool in the countries of the ECAFE region was increased more than twice, namely from US$305.5 million to US$715.4 million (see Table 3).

The expansion of import of machinery and equipment is, of course, a necessary measure for the development of engineering industries. However, it has its limits, due to the lack of the balance of payments, which is a characteristic feature for most of the developing countries. Moreover, the lack of qualified personnel makes it impossible to adapt the equipment imported as a consequence to use it fully.

In order to improve this situation, the developing countries should pay more attention to the development of their own research and design activities in the engineering industry and to train their local staff on the spot. The staff should be able not only to accept, but also to adapt the machinery and equipment imported from the developed countries.

There is no doubt that after a certain period of work with the imported equipment the local trained and qualified staff will be able to participate actively in design and research of the machinery manufactured locally.

The development of industrial management techniques of the countries of the region can be accelerated by the transfer of technology from industrialized countries by the provision of patents, licences, know-how, trade marks, management and other technical services.

7. Transfer of Modern Technology

Developing countries have an opportunity for adopting more advanced forms of technology without having to pass through the long period of research, experiment and adaptation experienced by industrialized countries.

One of the most elementary forms of the transfer of technology is by the sale of drawings. This form is only satisfactory, however, where the recipient organization has had considerable experience in the manufacture of similar products. Once the drawings have been handed over, the supplier has no further obligation and the buyer must rely on his own resources for their utilization in manufacturing.

It is usually considered more satisfactory to enter into an agreement for a supply of the drawings of a product, in addition to the technical information necessary for its manufacture.

The know-how may be in the form of written instructions for the manufacture of each constituent part and may include sets of drawings for all the jigs and fixtures required for production. It is usually desirable for a team of technicians to be present at the works in the developing country to assist in the initiation of production suitable for local conditions. The local staff could be sent to learn the manufacturing process and to familiarize themselves with the equipment at the plants of the company concerned.

A machine tool building industry in any country must satisfy the needs of machines, shapers, planers and milling machines. The production of machine tools may differ in respect of types and quantity depending on the needs of the developing country. A plant should be designed to produce a range of machine tools, fixtures, accessories and pneumatic tools that are in the greatest demand. With planned production, it is possible to operate a plant profitably.

Assistance could be provided by the developed countries or more advanced developing countries by means of bilateral agreements, or through UNIDO, for exploratory and design work, or in consultation with local specialists on certain aspects of design, production, testing, quality control, proper utilisation, maintenance and repair of machine tools.

Consulting firms in the supply countries are prepared to undertake the following steps in the creation of machine tool building plants:

- Determine the optimal production programme;
- Participate in working out the project report;
- Take part in selecting the site for the plant;
- Take part in the selection of the initial data required for the design and construction;
- Work out the project report, and upon approval by the Government, prepare the working drawings required for plant construction.

Apart from the design work, the supply countries could undertake the delivery of complete sets of equipment, instruments, apparatus and materials, or part of them, for the construction of a plant in accordance with the project plan. In addition to the conventional equipment of batch production, auxiliary non-standard equipment, for instance, interdepartment transport, special conveyors, hoisting mechanisms, test rigs, ventilating and electrical equipment, painting, heat treatment and other facilities could be furnished.

If the recipient country can produce such equipment, working drawings should be made and handed over to the recipient.

Consulting firms could also furnish the technological documents for the production of certain models of machine tools, namely:

- Technological charts, covering all operations of machine tool production;
- Working drawings for special fixtures required in accordance with adopted production technology;
- The organization of production, including the management structure of individual departments, the hiring of plant staff, their rights and obligations, the planning of office management and the supply of forms for interplant record keeping.

Supply countries could undertake to deliver special technological fixtures in the form of devices, attachments, dies, special cutting and measuring tools and intruments required for machine tool production, including parts and standard articles for machine tool assembly. In addition, technical assistance might be offered in the construction and setting up of production, by sending specialists to supervise the construction, to initiate operations for the production of machine tools and to train technicians of the recipient country. Training courses could be arranged for staff and specialists in industrialised countries.

Upon request, machine tool plants could be constructed in two or three stages, spreading the cost over a longer period. During the first stage

the recipient country could organize the assembly of machine tools, producing simple parts, on purchasing them in the country, while importing the complicated parts.

During the next stages, the parts locally produced will gradually increase as the production technique is mastered, providing it is advantageous to manufacture them.

In more advanced developing countries, where effective engineering industry has been established, another type of co-operation may be adopted. In this age of rapid technical evolution, it is not possible for a country to be self-sufficient and produce every type of machine tool required.

It would be desirable for the industry to concentrate on the design and development of a certain range of machine tools, a process that could be accelerated and expenditure reduced by co-operating with machine tool firms in neighbouring countries. This would save foreign currency by the production of various types of machine tools in the region.

In order to achieve a greater productivity of machine tools in developing countries, to improve their quality, to reduce production costs, and to use the installed capacity fully, special care should be taken in the introduction and application of methods of progressive measuring control.

Developing countries should make greater use of welding technology and equipment. Welding is a simple and cheap process and consists of joining and cutting various parts of machines. It could be most useful for the countries of the region in maintenance and repair, as well as in the production of various types of industrial, agricultural and transport equipment.

As it is possible to produce welds with the same mechanical properties as the base material, welding is used extensively throughout industry. This technique reduces the weight of equipment and increases production. The process of welding is not complicated, nor does it require highly skilled personnel and it can be undertaken by any country.

The poor quality of production of various kinds of engineering products is the main factor which prevents most of the developing countries from expanding their industrial production, import substitution and export promotion. Some of the developing countries have to buy tools, dies, jigs and fixtures needed for production. Some have to buy the proper steel in

order to manufacture their own tooling. All these procurements require foreign currency, which is very often rare in developing countries. Besides the introduction and application of progressive measuring and controlling methods, financing as well as skilled labour are required. Most of these and other intractable difficulties confronting the developing countries could in large measure be resolved by the introduction of numerically controlled machine tools.

The main advantages of NC which may be considered relevant in the case of developing countries are:

- reduction of setting up time
- elimination of complex jigs and fixtures
- the improvement of quality
- greater accuracy and better repeatability
- substantial reduction in human errors
- reduction of inspection and measuring instruments
- greater operator safety
- greater operator efficiency
- reduction of scrap
- reduced lead-time for production
- minimal spare parts inventory
- greater machine tool safety
- greater machine utilization
- the possibility of using less skilled labour to operate the machines.

The details on NC machine tool justification, advantages and disadvantages, selection, application and specialists required are described in the paper "Problems of Introduction of NC Machine Tools in Developing Countries" (UNIDO/ITD.190, 31 May 1973), prepared by Mr. N.N. Krainov, UNIDO, and presented at the Seminar on the Application of Numerically Controlled Machine Tools. The Seminar was organised by the Economic Commission for Europe (ECE) and held in Prague, Czechoslovakia, 12-17 November 1973.

PART III

PRESENT SITUATION WITH MACHINE TOOLS IN THE COUNTRIES OF THE REGION AND OUTLINE OF THE UNIDO ACTIVITIES IN THIS FIELD */

1. Present situation with Machine Tools in the Countries of the Region

The two industrially developed countries of the Region, namely the USSR and Japan, included in this study, have achieved great success in the production of machine tools within a rather short period of time. Both of them are now within the group of four main world machine tool producing countries.

BANGLADESH

Since 1971 all manufacturing industries have been taken over by the Government and 29 engineering companies, ranging from shipbuilding to bicycle manufacturers, have been controlled by the Government owned Bangladesh Engineering and Shipbuilding Corporation.

There are two factories engaged in machine tool manufacture. They are Tejgaon Engineering Company, which is a part of Rahim Metal Industries Corporation and the Bangladesh Machine Tool Factory at Joydevpur near Dacca.

The Tejgaon Engineering Company manufactures 100 mm and 175 mm centre height lathes. However, the Company is manufacturing only 36 units per year, which are of old fashioned design and rather low quality. The factory is equipped with a number of machines made by the Company themselves, which were copies of imported machines, vintage 1900 to 1920, except for one hobbing machine, which is probably 10 years old.

The Bangladesh Machine Tool Factory (BMTF) was planned about 1966. The factory employs 1,100 people, but its production is very limited. It assembles machine tools from imported parts and makes low-lift pumps for agricultural development programmes. The total cost of the factory to date amounts to US$10,0 million. The cost of new lathes, milling, grinding, drilling, shaping, slotting, hacksaw, jig-boring, measuring and gearchecking machines, mostly of Swiss origin, is about US$5,0 million.

*/ For the preparation of this part of the report, the author used some data from the UNIDO consultant's mission report to these countries, and from other information available in UNIDO.

In 1968 a license was granted by Muller and Pesant of Belgium for the manufacture of their centre lathes. Bench drills, pillar drills, radial drills and wood working machines are also to be manufactured. A supply of completely machined components for assembly at Dacca were obtained prior to the war and assembly was commenced, but was interrupted until 1973.

In 1973 the factory assembled and sold 54 bench drilling machines, 3 pillar and radial drilling machines, 57 lathes and 2 woodworking machines

It is expected that in addition to the local production, the factory will import components for assembling machine tools. Lathe parts are due to be imported in 1974 at a value of one million taka and 1975 at a value of two million taka. Additional machine tools for the factory have been ordered from Czechoslovakia with a total value of six million taka, including two planning machines with 6 and 8 meter machining length; one horizontal boring machine; one vertical boring machine and gear shaping machine.

Utilization of the existing capacities is very low (sometimes less than 20%) because of the lack of skilled labour and the shortage of raw materials and components.

The Planning Commission Report, June 1973 proposed investments in BMTF during the period 1974/78 for the amount of 288.18 million taka (approximately US$36,0 million) comprising of 109.03 million taka abroad and 179.15 million taka in local expenditure. The total capacity of the factory will be 12,000 tons of castings, forgings and completed machines. A major foundry building at BMTF is under construction and scheduled for completion in 1974 with plant installation during 1975. A second foundry and forge are also planned.

In order to improve the present situation in metalworking industries - particularly with a view of training local labour in design and production, planning and control techniques, management, etc. - the Government of Bangladesh is considering the establishment of a Centre for Technological Research. This institute is expected to be formed on the basis of the existing Bangladesh Industrial Technical Advisory Centre (BITAC), which has a tool design department, a small foundry and a small, well equipped machine shop. BITAC runs courses for machine operators, supervisors and foremen; provides design services and manufactures tools and jigs for local manufacturers.

INDIA

The production of machine tools in India was started at the end of the colonial period. The range of machine tools produced was very limited and they were very simple. By 1960, 70-80% of the whole demand of machine tools was covered by import. At that time India did not manufacture heavy machines at all. In 1950 the volume of the machine tool production in India was US$40,000. Import of machine tools in 1949 was US$600,000. In 1949 the Government of India secured assistance from Oerlikon Machine Tool Works (Switzerland) in establishing the first machine tool building plant (HMT) in Bangalore, which was completed in 1955. In 1961, India constructed the second machine tool building plant in Bangalore. These two plants in Bangalore are manufacturing lathes (including single spindle, capstan and turret), milling machines (horizontal, vertical and universal type), boring and drilling machines, external cylindrical grinding machines, and special purpose machines.

In 1963/64 the volume of production of these two plants was US$1,3 million. Taking into account the increasing local and outside demand in machine tools, in 1961 the Government of India decided to create three more plants within Hindustan Machine Tools Limited (HMT); namely, in Pinjore, Kalamassery and Hyderabad. The plant in Pinjore, constructed in 1963, is manufacturing milling machines, gear cutting machines and special purpose machines.

The fourth factory was constructed in Kalamassery in 1964. The plant is manufacturing universal turret and precision lathes.

In 1965 the fifth factory in Hyderabad was completed for manufacturing of special purpose machines. The 1968 census recorded 382,000 machine tools in the country. 246,300 were metal cutting machine and 86,400 metal-forming machines. The remainder were welding, die-casting and other machines. About 60% of the machine tools are used in the large-scale sector of industry. Nearly two-thirds of all machine tools in the country are of Indian manufacture, although many of the larger and more complex machines have been imported. 63.7% of all machine tools are less than 10 years old and 16.1% are more than 20 years old.

The Indian machine tool industry currently produces about 12.000 metalcutting and metalforming machine tools per year. About 85% of the output is produced by the 125 machine toool companies recognized by the Directorate General of Technical Development as comprising the machine tool industry. The remaining 15% come from the unorganized and small-scale sectors of industry and comprises mainly small and simple machine tools. Of these 125 machine tool companies,

including HMT and Praga Tools Corporation in Hyderabad, four companies are in the public sector and are controlled by the Government. The remaining 121 companies are in the private sector. The output of the four companies in the public sector represents more than 50% of the total production of machine tools. HMT includes five machine tool building factories, and is much larger than the others and produces about 50% of the total production of machine tools in India. Hindustan Machine Tools Ltd. employs about 12,000 persons in the production of machine tools. The four companies of the public sector employ about 17,000 persons. The total number of people employed by machine tool industry in India is about 27,000 people.

During 1972/73 the volume of the HMT machine tool production was about US$28 million, while the total machine tool production in India including small tools and accessories was US$70 million. The company, in co-operation with Kearney and Trecker Marwin Ltd.(KTM) Brighton, UK, completed the design and construction of a NC lathe which was shipped to the UK firm for extensive trials. Besides this, HMT is engaged in designing NC Machining Centres joinly with KTM. The Indian engineers, in co-operation with the Central Machine Tool Institute (CMTI) and Bharat Electronics Ltd., are evolving designs of NC systems, for machine tools.

There are 156 collaborations[1/] involving 15 countries and covering 33 products which include almost all types of machine tools and accessories including metal cutting (98 collaborations) and metal forming (16 collaborations) machine tools. 126 collaborations are placed within the 57 machine tool enterprises of the private sector and 30 collaborations within 4 public enterprises. India has 44 collaborations with UK, 37 with the FRG, 17 with the USA, 15 with France, 13 with Switzerland, 7 with Japan, 5 with Italy, 4 with Czechoslovakia, 3 with the GDR and the rest of the collaborations with other countries.

1/ A joint venture between two companies for one product is considered as one collaboration

INDONESIA

There are approximately 70 medium and large metal products manufactured under the responsibility of the Directorate General for Basic Industries. One of the most urgent needs of the metalworking factories is to up-grade the quality of their products and management and to rehabilitate their existing machinery and equipment. The Government has established a Metal Industry Development Centre (MIDC) through Belgian bilateral assistance with the aim to support the local manufacturers, provide extension services to them and actively participate in the management-development-programme. At present, the Government of Indonesia is considering to broaden the scope of the bilateral aided MIDC by supplementing assistance from UNDP/UNIDO in specialized fields such as tool design and development, metrology, design of agricultural equipment and provision of material testing facilities.

In addition to the above, the Government has decided to form a Manufacturers' Association (Metal Products) in order to improve the present situation of the metalworking industry. This association will actively participate in the management-development-programme as well in the activities of MIDC.

JAPAN

In the area of machine tool production, Japan ranks fourth in the world, after the FRG, the USSR and the USA. The production of machine tools in Japan in 1960 was only US$125 million and in the last 10 years has increased about 10 times and in 1970 was US$1,109.4 million.

The export of Japanese machine tools came into full scale in about 1962. In 1971 the total export of their machine tools amounted to US$80.1 million and was directed at the following countries: China (18.7 million), South Korea (11.1 million), USA (7.6 million), Australia (4.5 million), USSR (3.8 million), FRG (3.3 million), Burma (2.5 million), Indonesia (1.05 million), Thailand (0.9 million) and Philippines (0.7 million). The remainder was exported to other countries.

Remarkable progress in the area of technical innovation in the Japanese machine tool industry can be seen in the development of techniques of operating numerical controlled machine tools and high speed grinding machines.

It is noticeable that in 1956 the Government took encouraging steps for the machine tool manufacturing industry. With the official encouragement, manufacturing companies concerned exerted strenuous efforts in the attempt to develop original machines with their own ingenuity. The Mechanical Laboratory, Agency of Industrial Science and Technology, Ministry of International Trade and Industry, gave full-scale co-operation to these engineering firms in technical guidance, in the inspection of the result of their work and so forth. Meanwhile, the Government's Mechanical Laboratory had its own plan to develop a numerically controlled jig boring machine and succeeded in completing the planned NC borer with a repeated positioning accuracy of +0.001 mm. The Mechanical Laboratory also worked up an NC milling machine capable of continuous pass control cutting. Just at that time, Tokyo Institute of Technology made a success in the research and completion of NC lathes.

At the present time, such a large number of NC machine tools are being turned out that production of NC machine in 1970 was about 20% of the total machine tool output. There are 116 firms belonging to the Japan Machine Tool Builder's Association which account for more than 90% of the total machine tool production of Japan, and other 200 to 300 smaller machine tool builders.

In 1973 the preliminary value of the machine tool demand in Japan was 290,474 million yen; production - 304378 million yen; export - 35,236 million yen; andd import - 21,332 million yen. 2,754 NC machine tools, at a value of 47,316 million yen, were produced in J apan in 1973.

MALAYSIA

The engineering industry in Malaysia is comparatively small, but appears to be growing rapidly. There are no metalworking machine tool companies in the country, but there are two woodworking machine companies, both making a fairly wide range of machines in small quantaties and also producing other products such as speed reducer and water pumps, which are becoming their principal products. The Government of Malaysia, in co-operation with Sori Renoult Engineering Co., has undertaken a prefeasibility study of machine tool manufacturers in Malaysia both for metal cutting and woodworking machines. The study recommends a fairly small plant employing 150 persons, making a wide range of both metalcutting and woodworking machines.

There are over 150 foundries in Malaysia employing about 3,000 workers. The total tonnage of grey iron castings produced is estimated to be 12,000 to 15,000 tons per year, depending on the demand. A small quantity of non-ferrous castings is also produced.

Most of the existing foundries and mechanical workshops are small scale, based on traditional skills and outdated equipment. Cost, quality, material and production control does not exist except in a few enterprises. Lay-out material handling and maintenance also need considerable improvement.

There is also a need for assistance in the manufacture and maintenance of tools, dies, moulds, jigs and fixtures for the mechanical, electrical and plastic industries. Local expertise in these aspects is not available. The light engineering and plastic industries in Malaysia, already set up or being set up under the present industrialization programmes, involve a wide range of products, such as bicycles, sewing machines, electric fans, builders' hardware, automobile components, wire and wire products, bolts and nuts. The plastic conversion units alone number over 150. The total number of people employed in the plastic conversion units is estimated to be about 2,800. Most of these light engineering industries do not have tool-making facilities of their own so most moulds and tools are imported. The importation of tools, dies, moulds, jigs and fixtures is very costly, mainly because of freight charges. Also, delivery usually takes a long time. About M$3.0 million are being spent yearly on importing moulds for the plastic industry alone. The lack of these tools, etc. is one of the reasons for the under-utilization of the available capacity in the country. The few moulds and tools which are produced in the country have a limited life and their quality is well below international standards .

Another factor which inhibits the setting up of tool making facilities is the lack of trained and skilled tool makers. Many overseas enterpreneurs hesitate to invest in any industrial undertaking which requires tools, dies, jigs, moulds and fixtures, unless tooling services are readily available in the country. For this reason, it is desirable to establish modern toolrooms and train the necessary skilled labour.

PAKISTAN

A large number of private and Government owned re-rolling mills, foundries, machine-building, metal products and some other engineering industries in Pakistan have been established without much planning as to capacity and demand. In 1971, a team of three UNIDO experts provided assistance and advice to the country on co-ordination and efficient utilization of the steel, iron and engineering industries. It was noted that in many factories there is an under-utilization of installed capacities, which is 55-65%. The engineering industry in Pakistan is highly decentralized. It is estimated that there are 1,700 production units containing about 21,000 machine tools of which 800 units with about 2,680 machine tools, employ less than 10 workers each. At the same time, 11 large plants providing aggregate employment of 45,000.

There are two public enterprises which are involved in the production of machine tools in the country, namely, the Pakistan Machine Tool Factory (PMTF), at Landhi near Karachi, which is under the State Heavy Engineering and Machine Tool Corporation, and the Machine Tool Division of Pakistan Engineering Company (PECO) in Lahore, which is under the Ligh Engineering Corporation because of the wide range of other engineering products produced by the Company, including their main product, bicycles.

PMTF, employing 3,500 persons and working on a double shift system, in addition to combined gears and transfer boxes for Jeeps, rear axles and brake drums for Bedford trucks, manufactures milling machines under a licence from Oerlikon (Switzerland) and Herber (UK). However, in 1973 the plant could produce only 70 machines in total, and of these, only 35 machines were sold to customers.

The Machine Tool Division of PECO manufactures centre lathes, small hand operated turret lathes and shaping machines and has the capacity to build 600 machines per annum, but at the present time is selling only 200-300 machines per year. Many of the machines, some in partly finished condition, have been in stock for a considerable period of time.

The private sector of industry, mostly located in Lahore, also produces machine tools. However, the quality of their production requires future improvement.

In spite of the difficulties, the local private sector industry is getting technical assistance and consultancy services from the Pakistan Industrial Technical Advisory Centre (PITAC) in design and production of toolings.

THE PHILIPPINES

There are about 1,500 metalworking establishments, dispersed throughout the country, manufacturing various metal products, utilizing some 260,000 to 300,000 machine tools of all types. Almost all of these machine tools have been imported since domestic production is minimal. The machine tools imported in the country are mostly the general-purpose types, such as engine lathes, universal milling machines drill presses, shapers, grinders, power presses, etc. Special types of machine tools, such as automatic lathes, gear hubbers, etc. are used by a few industrial firms for the manufacture of metal products or parts.

Taking into account the importance of local manufacturing of machine tools, particularly lathes, shapers and drill presses, the Government of the Philippines is including this industry in its Investment Priorities Plan under "pioneer" status.

The local companies are manufacturing about 300 presses per annum. The Machinery and Steel Products Engineering Company manufactures 100 presses per year, including mechanical presses (5 to 80 ton capacity) and hydraulic presses.

At the present time, the local industry is not producing metalcutting machines in the country. However, the Machine Tool Manufacturing Company has been established, employing about 40 people on jobbing work making small castings and re-building textile looms.

This company, registered with the Government for the manufacture of lathes, has a licensing agreement with Hindustan Machine Tools Ltd. (HMT), India. This company will produce 400 mm x 1,000 mm engine lathes with a volume of 106 units in the first year of operation, increasing to 1,900 units in the tenth year. The company will make use of components or parts to be manufactured or procured locally. HMT will provide documents, drawings, information and its technical expertise. The training of the local company's personnel will be arranged in India.

Another local company, whose application for registration has been approved, will manufacture lathes and shapers. This is a joint venture with Ta Shing Machine Works Ltd. of Taiwan, in which the local firm will contribute 60% of the equity and Ta Shing the balance. The company is expected to produce 240 lathes and 96 shapers in the first year of operation and 1,320 lathes and 312 shapers by the tenth year.

There is a third company which proposes to manufacture drill presses of various capacities. It will produce 96 units in the first year and 1,000 units in the fifth year of operation.

A fourth domestic company will have a joint venture with a foreign firm for the manufacture of lathes and vertical milling machines. This company is expected to be operational by the middle of 1975. Approximately 50% of its production will be for export.

The number of machine tools to be produced, imported and exported by the Philippines in 1975 and 1985 is shown below:

Machine Tools	Production			Import			Export		
	1970	1975	1985	1970	1975	1985	1970	1975	1985
milling	-	-	400	320	730	1,100	-	-	200
drilling	-	800	1,000	2,000	2,300	3,900	-	20	50
grinding	-	120	320	400	620	940	-	20	60
lathes	-	250	3,000	3,200	3,800	5,800	-	20	120
presses	150	230	500	480	730	1,100	-	10	60
other machines	-	200	2,000	1,556	2,220	2,760	-	20	200
TOTAL	150	1,600	7,220	7,956	10.400	15,600	-	90	690

There are presently about 150 firms casting metals locally. These foundries are dispersed throughout the whole archipelago with an overwhelming concentration in the Greater Manila Area, where roughly 75% of the foundries are located. About 20 firms control 75% of the total foundry output. The other 25% of total production is distributed among 121 firms. The remaining nine are technical schools and government agencies with minimal foundry operations. Most of the foundries are basically jobbers.

Among metalworking manufacturing firms there are two companies: one for production of such hand tools as wrenches, spanners, pliers and screw drivers; the other produces metalworking files.

SINGAPORE

A number of machine tool manufacturing companies have been established in Singapore. Negotiations are in progress concerning the creation of four more manufacturers. The local manufacturers are producing or are going to produce lathes, injection moulding machines, heading machines, saw sharpening and servicing machines, surface and internal grinding machines, tools and dies, in accordance with licences from the USA, FRG, Japan, India and Australia.

Okamoto Machine Tool Works Ltd. of Yokohama will open a wholly owned subsidiary in Singapore by the end of this year to manufacture surface grinders, some of which will be exported to the USA.

The new Singapore company will be capitalized initially at about $1 million and may later be increased to $4 million. Okamoto plans to manufacture 180 surface grinders in the first year of operation and to export a third of them to its sales company in the USA, Okamoto Corp. of Chicago.

Okamoto is said to be the first Japanese machine-tool maker to venture into Singapore. The company was attracted there by the availability of low-cost labour and the Singapore Government's tax concessions for export-oriented firms, and official of the company said.

Okamoto now exports 50 to 60 surface grinders and gear grinders per year to the USA. The surface grinders sell for about $10,000.

Almost one hundred workers will be employed intially in the Singapore factory.

SRI LANKA

The metalworking industry of Sri Lanka is very dynamic and production has grown spectacularly in recent years. The total output volume rose from RS 206 million in 1965 to about RS 800 million in 1972. It is at present a blend of small, medium and large enterprises. Some units have operated for more than 50 years. Sri Lanka produces rolled steel and drawing products, cast iron and steel castings, tea machinery, rubber and paddy processing equipment, etc. and the assemblying of cars has been initiated. Moreover, machine tools, dies, jigs and fixtures, agricultural implements as well as tractors and some other equipment may be assembled and manufactured successfully. However, manufacturing technology, precision, workshop organization and quality control are behind modern industrial standards.

A survey of machine tools conducted by the Ceylon Steel Corporation (CSC) shows that the number of metalcutting machine tools installed in Sri Lanka's workshops would not be smaller than 4,000 and may be in the range of 7,000 units. The number of metalforming machine tools is considerably smaller, amounting to about 1,300 units. Most of the equipment is obsolete, and requires repair and rebuilding.

In some plants the machine tools used are more than 20 to 30 years old, and are worn out. In some shops, the machine tools were also completely worn out, although they are only about eight years old. This sad state of the machine tools is primarily due to the lack of maintenance and abuse by operators who are insufficiently trained. Some machine tool operators seem to think that cleaning and oiling their machines is not part of their jobs, but that of a sweeper, and machine tools, therefore, deteriorate more quickly.

The need for newer machine tools in all the shops of Sri Lanka is quite obvious and generally recognized. At the present time, the Ceylon Steel Corporation, which employs about 1,200 people through its machine tool division, handles all imports of machine tools in Sri Lanka.

The import of machine tools from the USSR and India is shown below in numbers and millions of Ceylonese rupees.

Countries	1971		1972		1973	
	in numbers	in million rupees	in numbers	in million rupees	in numbers	in million rupees
USSR	70	1,108	56	1,191	91	2,337
India	17	426	40	2.178	26	894

An unsatisfied demand exists in Sri Lanka for all types of machine tools for 1974 in the amount of 6 million rupees. Due to the scarcity of foreign exchange, only a limited number of machine tools can be imported. There is a great demand for simple machine tools in Sri Lanka, which will provide a good start for the Ceylon Steel Corporation in the machine tool building field. The CSC has already started to build pedestal grinders, for which the Hindustan Machine Tools Ltd. in Bangalore has furnished the drawings. The Government is setting up a Machine Tool Production Shop, a Tool Room and Machine Tool Rebuilding facilities. Two buildings about 90x40 feet each have been assigned to the Machine Tool Division of the CSC.

It is planned that the Division will be involved in the continuation of manufacturing and assembling of pedestal grinders; repair and rebuilding of used and older machine tools; design, making and grinding of single point HSS-tools and milling cutters; and design of machine tools that can be produced with the facilities available and a minimum investment in additional tooling and equipment.

THAILAND

The engineering industry in Thailand consists mainly of small units which are privately owned but encouraged by the Government. There is very little Government controlled industry, but a company whose project is approved by the Board of Investment receives considerable financial advantages, including tax concessions and duty free importation of equipment.

There are a few small companies which are manufacturing rather crude machine tools. Thus, Messrs. Chokdee Co. produces 120 small, simple, old-fashioned centre lathes, the prices of which are between US$1,300 and US$4,000, depending on their size.

There is a company at Pak-Num, near Bangkok, which planned machine tool manufacturing some years ago, but found it difficult to retain a sufficient number of skilled labour. It has, therefore, concentrated on importing used machine tools, doing some reconditioning on these where necessary and also running a gear cutting service to meet the needs of other companies. At the present time, 80 people are employed by the company.

The Pressure Container Industry Corporation Ltd., which is extremely well organized, is producing good quality products and is exporting 80% of its production to many countries of Asia. The company is expected to start manufacturing lathes under the licence of the South Bend Company (USA).

The import of machine tools in 1970 and 1971 in numbers and value in US$ is shown below.

Type of machines	1970		1971	
	number	US$	number	US$
Lathes	1,559	881,000	1,784	1,074,000
Planning, shaping and slotting	1,214	546,000	2,112	861,000
Drilling and boring	3,566	476,000	5,447	622,000
Milling	107	3,586,000	127	88,700
Sawing and cutting	1,971	470.000	2,164	587,000
Grinding	4,227	466,000	4,671	332,000
Wire drawing	40	809,000	17	109,000
TOTAL	12,680	7,227,000	16,322	8,673,700

USSR

The stock of machine tools in Russia in 1914-1917 was about 100,000 units and only 20% of them were produced locally. By 1971 the stock of machine tools had reached 3,300,000 units, 90% of which are produced by the USSR. (The stock of machine tools in the USA is 3,100,000 units).

In 1917 less that 20% of engineering products were manufactured with machine tools which were produced in the country. In 1928 this figure rose to 24% and now it has reached 90%.

The production and stock of machine tools in the USSR is shown below 1/.

Years	Number of Machine Tools Produced	Stock of Machine Tool	Number of Machine Tools Produced Locally	Percentage of the Stock	Percentage of Local Production to the stock
1914-1917	n/a	100,000	20,000	100	20
1940	58,400	710,000	n/a	100	n/a
1950	70,600	1,507,000	n/a	100	n/a
1960	155,900	2,000,000	n/a	100	n/a
1969	205,780	3,000,000	n/a	100	n/a
1970	n/a	3,300,000	2,970,000	100	90
1972	210,000	n/a	n/a	n/a	n/a
1973	213,000	n/a	n/a	n/a	n/a

NOTE: In the preparation of the table, some data was used from the magazine "Stanki i Instrument" No.4, April 1970; and from "American Machinest", 21 January 1974

For a period of 1965 - 1969 1/ the stock of metalcutting machine tools increased by 18.8%, and metalforming machines by 26.2%. The more rapid increase of this production of machine tools is a characteristic figure of the present development of machine tools.

It is expected that in 1975 the USSR will produce 250,000 units.

1/ "Stanki i Instrument" No. 3, March 1971

2. UNIDO Technical Assistance Activities

In the field of metalworking industries, and particularly machine tool industries, UNIDO technical assistance to developing countries consists of the following three basic types of activity:

(a) Operational activities, involving direct assistance to developing countries;

(b) Supporting activities, including action-oriented studies and research and promotional activites, through which UNIDO seeks to mobilize resources, far greater than its own, by encouraging direct contact between the business communities in industrialized and developing countries.

(a) UNIDO Operational Activities

UNIDO is giving technical assistance to the developing countries in the form of project financed through:

- UNDP Indicative Planning Figure (IPF) -- IPF projects, included in the Country Programme (usually large scale projects, including expertise, equipment and fellowships)
- Special Industrial Services Programme (SIS) - SIS projects (sending of experts for a period of up to 12 months)
- UN Regular Programme (RP) - RP projects
- UNIDO Voluntary Contribution (VC) - VC projects
- UNIDO Trust Fund (TF) - TF projects (financing the supply of industrial equipment in order to complete the financing of UNIDO's technical co-operation with the traditional programmes)

UNIDO has provided, or is providing, technical assistance in the field of selection, utilisation, design, production and maintenance and repair of machine tools and their accessories including various kinds of tools, dies, moulds, jigs and fixtures to Argentina, Brazil, Bulgaria, Egypt, India, Indonesia, Iran, Malaysia, Mexico, Pakistan, Peru, Philippines, Romania, Singapore, Sri Lanka, Turkey and other developing countries.

UNIDO is encouraging the development of engineering design capabilities in the countries of the "third world". In this connection it is necessary to note that UNIDO assisted the Government of Egypt in the establishment of the Engineering and Industrial Design Development Centre (EIDDC) in Cairo. The

Centre was started from scratch and is being implemented in two phases. The total UNDP contribution for the Project is US$2.6 million and covers the provision of experts, fellowships and the supply of equipment and technical information required for the activities of the Centre. The total Government contribution for this Project is LE 1.6 million and covers the provision of land, buildings, some equipment and local staff.

Phase I of the Engineering and Industrial Design Development Centre lasted for a period of five years from 1968 to 1972.

During Phase I of the Project, UNIDO experts trained local engineers, technicians and draftsmen in design and production of prototypes of such engineering products as agricultural trailers, belt conveyors, concrete mixers, solar heating equipment, bicycles, electric irons, tools, dies, jigs and fixtures, etc. Technical assistance was given to the local manufacturers on the establishment of technical and engineering design departments in their factories. Thus, a design department was created in the El NASR Automotive Manufacturing Co. The Centre helped to reconstruct factories by introducing new lay-outs to such manufacturers as Spring and Transport Needs Manufacturing Co., Alexandria Metal Product Co., Cairo Metal Product Co., Ghamra Factory.

Phase I of the Centre was completed by the end of 1972. Recognising the importance of the Centre in the development of engineering industries and, particularly in the promotion of engineering design capabilities in the country, the Government of Egypt has decided to expand the activities of the Centre. In order to promote the local design and manufacture of processing industries equipment and to strengthen the local production of tools, the Government of Egypt has asked for UNDP/UNIDO technical assistance for Phase II, which started in 1973. The duration of Phase II is six years (1973-1978) and the UNDP contribution is US$1,6 million while the Government contribution is LE 832,480.

During the past five years the Centre has grown into an organisation of more than 150 employees. It is co-operating with more than 12 factories affiliated to the Egyptian General Organisation for Technical, Electrical and Electronic Industries and to which the Project is connected. More than 60 new products, 300 tools, numerous layouts, organisations and projects have been designed, planned and executed. 70 engineers from various factories have had the opportunity to work at the Centre.

At the International Industrial Exhibition, which was opened in Cairo on 9 March 1974, the EIDDC had, for the first time in its history, its own stand where there were shown such designed and produced engineering products as solar heaters, cement mixers, battery chargers, scooters for children, motorcycles, cooling refrigerators, electrical switches, invalid cars (Fiat 125 and 128), gas cookers and some tools.

The EIDDC stand was among others from local factories with which the Centre has close co-operation.

The Centre's activities were reported on radio and TV. Articles, with pictures, describing the activities of the Centre in design and production of prototypes of engineering products were published in various newspapers.

In the Philippines, UNIDO assisted the Government in the establishment of a Metal Industries Research and Development Centre. The assistance began in 1971 and is scheduled to terminate in December 1977. The total UNDP/UNIDO input amounts to US$2,150,000, which are divided as follows:

Expertise	US$1,150,000
Fellowships	200,000
Equipment	755,000
Miscellaneous	45,000
TOTAL	US$2,150,000

The main objectives of the Centre are to serve the varied and expanding needs of metal industries relating to extension services, applied research, introduction of adequate up-to-date technologies in such important engineering disciplines as tool and die design, making and its proper application, heat treatment, metalcasting and formability, instrumentation and its technology, mechanical maintenance and repair including machine rebuilding, metrology, quality control and inspection, product and machine design.

In Singapore UNIDO participated in a project similar to the one mentioned above, but executed by ILO, by providing expertise in heat treatment, tool making, metrology and cost accounting. The UNDP assistance terminated in December 1972. Eight Philippino fellows were trained in 1972 in the Metal Industries Development Centre (MIDC) in Singapore.

During a three year period a UNIDO expert (Mr. C. Knepell) formulated proposals on the establishment of a tool and die making industry and hardware industry in Singapore. The expert was able to attract foreign firms to create these industries in the country. Following his advice, a company for the

manufacture of carbon steel razor blades which are now being sold in foreign countries was established. Under the expert's technical guidance, a new factory for the manufacture of welded steel chains has been completed and automatic production equipment was installed.

The Ceylon Steel Corporation is an enterprise set up by the Government of Sri Lanka with a view of establishing metalworking industries in the country. The Corporation's steel rolling mill and wire products mill commenced production in March 1967 and aimed at integrating subsidiary industries, one of which is a machine tool unit for the assembly of lathes and pedestal grinders. This unit was established under the Technical Collaboration Agreement with the Hindustan Machine Tools, Ltd., India. The Ceylon Steel Corporation sold over 200 machines manufactured by the Hindustan Machine Tools Ltd. and assembled 25 lathes and 10 pedestal grinders.

Upon the request of the Government of Sri Lanka, Mr. A.O. Schmidt, UNIDO expert attached to the Machine Tool Division of the Ceylon Steel Corporation is providing technical assistance in the production, testing and installation of pedestal grinders as well as in the production of spare parts and replacements for the steel mills. The expert is demonstrating the correct regrinding of tools with proper angles and improving feeds, speeds and accuracy for machine tools. The necessity has been found to activate heat treatment facilities for tools and to design a tool holder for the more economical use of scarce, high-speed steel tool material. Training has been provided on the production and proper utilisation of machine tools, improvement of performance operation, sequencing and jig and fixture design for the machine tool shops. To insure a better selection of personnel for the Machine Tool Division of the Ceylon Steel Corporation, the expert has assisted in the preparation of 16 job descriptions for the posts required, starting from a Machine Tool Division Manager to a Machine Tool Operator.

The Government of Sri Lanka has expressed interest in the establishment of a National Research and Development Centre for metalworking industries engaged in the selection, utilisation and development of machine tools, tools, dies, jigs and fixtures. A UNIDO expert (Mr. F. Rajic) and a UNIDO staff member (Mr. N.N. Krainov) visited Sri Lanka to study the metalworking industries and to assist in the preparation of a draft request for the establishment of the Centre. It is expected that the Centre will be concerned with the research, design and prototype manufacture of units for machine tools and other industrial equipment.

The Centre will identify the product lines to be developed or adapted by industry. UNIDO is expected to supply equipment, to provide international experts, and to grant fellowships, while the Government will provide the facilities, simple equipment and counterpart staff for training.

Upon the request of the Government of Malaysia in 1972, a UNIDO/ILO mission which consisted of two UNIDO staff members (Messrs. N. Krainov and C. Popov) and two ILO consultants (Messrs. J.B. Brooke and H.F. Ross), visited selected foundries, mechanical workshops and plastic factories and studied the necessity of the establishment of Metal Industries Development Centre of Malaysia. The members of the mission, in co-operation with the Government authorities and the UNDP Resident Representative, drafted a Project Document for the establishment of the Centre in Malaysia. The Project has been included in the Country Programme of Malaysia and was approved by the Governing Council of UNDP in January 1972.

The total UNDP/UNIDO/ILO input amounts to US$1,339,750. The funds are divided as follows:

Expertise	US$ 573,750
Sub-contracts	45,000
Fellowships	88,500
Equipment	604,800
Miscellaneous	27,700
TOTAL	US$1,1339,750

The duration of the project is five years, and it will be started at the end of 1974. The main purpose of the Centre is to provide advisory services to the existing foundry shops and mechanical workshops and related enterprises in the design, production and application of a variety of castigs, dies, moulds, tools, jigs, fixtures and in repair and maintenance facilities; to assist local manufacturers in the establishment of their own toolrooms; and to collect and disseminate relevant data and technical information on modern techniques of the production of these items to the local manufacturing enterprises.

The UNIDO Regional Seminar on Machine Tools for Developing Countries of Europe and the Middle East, held in Bulgaria in 1971, noted that since 70 percent of the total machine output in Bulgaria consists of job and small batch production, it is particularly appropriate that numerical control should be introduced in the country as widely and quickly as possible. It was

recommended that the establishment of a NC Machine Tool Demonstration Centre in Sofia be very much desirable, because it will provide an advisory service on the economic justification and selection of NC machines; allow production engineers to see practical application of NC under production conditions; train production managers on the problems associated with the use of NC machines; arrange courses for programmers on data programming and tape preparation; advise on preventive maintenance, etc.

UNIDO delivered some lectures on this subject to more than 100 Bulgarian engineers and technicians in the Machine Tool Research Institute in Sofia. The lectures were followed by a film showing the use of numerically controlled machine tools.

In accordance with the recommendations of the Seminar, UNIDO provided fellowships for four Bulgarian engineers to be trained in this field in the USA. The fellows visited the International Machine Tool Show in Chicago, some manufacturers and users of NC machine tools, as well as attended the training courses devoted to this subject.

The next step in the implementation of the recommendations is a visit of an UNIDO expert to Bulgaria in order to assist the Bulgarian authorities in the formulation of the request for technical assistance for the establishment of the Centre, specifying the UNIDO experts, equipment and fellowships required.

Following recommendations worked out by the Regional Seminar in Bulgaria, eight Hungarian engineers received UNIDO fellowships in 1973, for three months each, to be trained in France and the FRG in the use of computers in industry.

In 1973 UNIDO provided technical assistance to Turkey in order to increase production and to improve the quality of machine tools manufactured in the country. An UNIDO expert worked in close co-operation with the Marmara Scientific and Industrial Research Institute located in Gebze near Instanbul and the National Productivity Centre.

Recommendations were made on the proper selection and effective utilisation of machine tools. It was also recommended to the Government of Turkey that they should create two institutions, namely - the Machine Tool Design and Development Institute and the Machine Tool Trade Association. The Turkish authorities are considering if the Design Development Institute should be a large one to cover the problems of all machine tool manufacturers in the country or a small one to cover the problems of only one company, namely MKEK, which is the largest public sector company in Turkey. There is no doubt that the creation of a Design Development Unit will promote the machine tool industries

in Turkey, improve their production quality and enlarge their market both in the country and abroad. The Machine Tool Trade Association in Turkey will be created by the local machine tool manufacturers.

UNIDO is requested to provide technical assistance in NC machine tools to the Centre Machine Tool Institute (CMTI) in Bangalore, India. The Institute has established a department exclusively for the development of Numerical Control systems. A systematic investigation for the utilization of indigenously available components, such as elements, tape readers and tape perforators, has been completed. The nature of the components manufactured in the various industries has been studied with a view of identifying parts that are ideally suited for production by NC. Such NC systems as point-to-point positional control system, straigh-cut system and digital road-out are developed in the Institute. The systems could be run on a fully tape-programmed cycle, which controls the main function, giving the required dimensional data, in addition to control of auxiliary functions such as feed, speed, etc. Alternatively, each operation can be carried out individually by manual selection of the input-data when only a few pieces are to be machined. All the circuits are fully transistorized and built as plug-in printed circuit boards facilitating maintenance and inspection.

A small number of machine tools with numerical controls has already been installed in India and more are likely to be installed in the coming years. However, the absence of suitable technical advisory services for economical utilisation of these machines is being keenly felt. In order to accelerate the introduction of NC machine tools, the Government of India has decided to ask for UNDP/UNIDO technical assistance in order to establish a Numerical Control Centre for the Metalworking Industry, to be attached to CMTI in Bangalore.

The Project duration is six years (1974-1979) and is included in the Country Programme for India. The total UNDP/UNIDO input amounts to US$1,500,000. The funds are divided as follows:

Expertise	US$ 450,000
Fellowships	131,500
Equipment	898,000
Miscellaneous	20,500
TOTAL	US$1,500,000

A team of three UNIDO experts has visited a large number of private and government owned re-rolling mills, foundries, machine tool building and metal products manufacturing industries in Pakistan and studied the causes of under-utilization of the installed capacities. Recommendations have been worked out on the proper application and utilization of existing machine tools in the country.

Upon the request of the Government of Indonesia, three UNIDO experts have assisted the local metalworking industries in the introduction of new pilot production systems with special operation cards, which improve the efficiency of the production. The experts analyzed the problems of under-utilisation of machine tool and related industrial equipment in Indonesian enterprises and recommended ways to improve this situation.

UNIDO is providing technical assistance to the Toolmaker's Institute in Jamaica in training the local staff in design, production, and maintenance and repair of tools, dies, moulds, jigs and fixtures. The UNDP/UNIDO contribution amounts to US$175,000 and includes the provision of expertise and equipment required for the Institute.

In 1972 UNIDO provided technical assistance to Brazil in the field of proper utilization of machine tools and in particular the efficient use of NC machine tools in Brazilian industry.

Recently requests for UNIDO technical assistance have been received in such fields as:

Argentina — assistance in the establishment of a Machine Tool Research and Development Centre including NC machine tools which could provide services not only to local manufacturers, but also to manufacturers in other Latin American countries;

Brazil — assistance in the manufacture of tools, dies, jigs and fixtures;

Corporacion Andina de Fomento (CAF) — on behalf of the Andean countries including Bolivia, Colombia, Chile, Ecuador, Peru and Venezuela, assistance was requested in the establishment of production centres for metalworking industries in the countries of the Andean group;

Peru	assistance to machine tool manufacturers in the improvement of quality of production;
Venezuela	UNIDO fellowships for training in the NC field upon the request of Industrias Metalurgicas Van Dam, C.A., Venezuela, UNIDO provided information on NC drilling and milling machines in which they are especially interested.

(b) UNIDO Supporting Activities

The UNIDO supporting activites in metalworking industries are aimed at the promotion of direct technical assistance provided by UNIDO to developing countries in order to help them to accelerate the process of industrial development.

The main types of UNIDO supporting activities are:

- organisation of expert group meetings, workshops, international and regional seminars and symposia to promote the development of metalworking industries in the countries of the "third world", and
- preparation of economic, scientfic and research surveys and publications.

The following meetings have been held by UNIDO on the problems of the development of metalworking industries in the developing countries:

i) Interregional Symposium on Metalworking Industries in Developing Countries, Moscow, USSR, 7 September - 6 October 1966

88 participants from 25 developing countries of Africa, Asia and Latin America and from 12 developed countries attended the Symposium.

The Symposium considered and discussed such important items as significance of metalworking for the national economy in the developing countries; review of metalworking industries in developing countries by regions; demand and supply of metalworking products; machinery censuses; some special conditions related to the establishment and promotion of metalworking industries; trade policies; import restrictions, tariffs and exports; investment policies - financing and foreign investment; the role of regional co-operation; quality of product; development and trends in metalworking; some special technological considerations for metalworking industries in industrially developing countries; research and development; cost considerations; standardization of metalworking; maintenance

and repair of metalworking machinery; degree of mechanization; replacement policies; manpower problems; planning and production management.

Three types of technical papers were prepared for the Symposium. The first one showed the state of metalworking industries; the second one discussed production problems in the metalworking industries; and the third showed economic aspects of the development of metalworking industries.

To promote the progress of metalworking industries in the developing countries, the Symposium made some recommendations for the developing countries as well as for the United Nations organisations responsible for the development of metalworking industries in the developing countries.

The Report of the Symposium has been published.

ii) Expert Group Meeting on Design, Manufacture and Utilization of Dies and Jigs in Developing Countries, Vienna, Austria, 18 - 22 May 1968

The Meeting was organized by UNIDO on an interregional basis. 15 experts from developing and developed nations discussed the present state and future trends in design, production and utilization of dies, jigs and fixtures, as well as economic aspects, ways and methods of organization of their production in developing countries. The recommendations on future activities of UNIDO and the developing countries in this particular field have been worked out.

The Report of the Meeting has been published.

iii) Expert Group Meeting on the Development of Engineering Design Capabilities in Developing Countries, Vienna, Austria, 11-15 May 1970

34 participants from 19 developed and developing countries and from International Organizations, including a representative from the International Council of Societies of Industrial Design (ICSID) attended the Meeting. The participants discussed such important matters as the identification of areas requiring design, costs of design and problems of prototype production, training in design, problems in the organization of design centres in these countries and the role of UNIDO in rendering technical assistance to these countries for the development of their capabilities in industrial design.

It was noted that successful industrial growth in developing countries depends to a considerable extent upon indigenous capacity to create and develop engineering design, as well as to adapt the designs of various kinds of products to be manufactured under licensing agreements in accordance with domestic needs. The engineering design capabilities of nearly all developing countries are

either lacking or at early stages of development. To permit the optimal use of available technology, this capability should be increased in these countries, whatever their present level of development.

The Meeting worked out recommendations and guidelines for decision on the future development of design capabilities and the production of prototypes of engineering products, machinery and equipment in developing countries.

The report of the Meeting has been published.

iv) Regional Seminar on Machine Tools for Developing Countries of Europe and the Middle East, Varna, Bulgaria, 18 - 27 October 1971

The Seminar, attended by 29 delegates from 19 countries, the Economic Commission for Europe (ECE) and the European Committee for Co-operation of Machine Tool Industries (CECIMO), stressed the importance of proper utilization and maintenance of machine tools in the countries of the region, of adapting modern technology in methods of manufacture and the advantages of close co-operation between developing and developed countries.

Meaningful discussions took place regarding the recent development in the techniques and processes used in the metalworking industry of the developed countries and ways in which these developments could be most effectively applied.

The Seminar was useful for both the developing and developed countries as many direct contacts were established that lead to mutually beneficial commercial and technical arrangements. In order to observe the production and utilization of machine tools under workshop conditions, and to study the experience gained in the creation and development of machine tool building industries, the participants visited machine tool and equipment plants located in Kazanlŭk, Stara Zagora, Asenovgrad, Plovdiv and Sofia. A visit was also made to the Research and Design Institute for Metal Cutting Machine Tools in Sofia.

At the end of the Seminar, lectures were arranged by UNIDO and delivered by representatives of developed countries to more than 100 Bulgarian engineers and technicians on the premises of the Machine Tool Research Institute in Sofia. The lectures were followed by a film showing the use of NC machine tools.

Recommendations were worked out for 13 countries of the region, taking into account the different levels in the development of their metalworking industries.

The Report of the Seminar has been published.

v) Regional Seminar on Machine Tools for the Countries of Latin America Buenos Aires, Argentina, 16-25 October 1972 and São Paulo, Brazil, 26-27 October 1972

The Seminar was attended by 94 representatives from 20 countries, the Economic Commission for Latin America (ECLA) and the European Committee for the Co-operation of Machine Tool Industries (CECIMO).

At the Seminar, 18 requests were identified for UNIDO technical assistance to 10 countries of the region. In addition, 38 projects were defined under the Investment Promotion Programme of the Seminar and contacts were established between interested parties which will result in mutually beneficial industrial co-operation arrangements.

Useful contacts were established between interested parties from the Andean Group countries, (Bolivia, Chile, Colombia, Ecuador and Peru) and industrialists from Argentina, Brazil, European countries and the USA. The programme of the Seminar included visits to major factories of the metalworking and machine tool industries in Argentina and Brazil. It was the unanimous view of the participants that the Seminar was useful to both developed and developing countries.

The Report of the Seminar has been published.

Since 1967, the year which UNIDO was created, the following studies and publications concerning the development of machine tools in the countries of the "third world", have been prepared and issued by UNIDO:

i) Report of the Interregional Symposium on Metalworking Industries in Developing Countries, ID/8, UNIDO, Vienna, 1968

ii) Development of Metalworking Industries in Developing Countries, ID/6, United Nations, New York, 1969

iii) Design, Manufacture and Utilization of Dies and Jigs in Developing Countries, ID/18, United Nations, New York, 1970

iv) The Selection and Acceptance Testing of Metal-Cutting Machine Tools (A Practical Guide for Developing Countries), ID/22, United Nations, New York 1971

v) Effective Use of Machine Tools and Related Aspects of Management in Developing Countries, ID/77, United Nations New York, 1972

vi) The Development of Engineering Design Capabilities in Developing Countries, ID/67, United Nations, New York, 1972

vii) Role of UNIDO in the Promotion of Machine Tools in Developing Countries of Europe and the Middle East, N.N. Krainov, UNIDO, ID/WG.87/29/ Corr.1, 31 May 1972

viii) Regional Seminar on Machine Tools in Developing Countries of Europe and the Middle East, ID/88, United Nations, New York, 1972

ix) Machine Tools in the Countries of Latin America, N.N. Krainov, UNIDO, ID/WG.113/13/Corr.1, 1 September 1972

x) Problems of Introduction of Numerically Controlled Machine Tools in Developing Countries, N.N. Krainov, UNIDO/ITD.190, 31 May 1973

xi) Machine Tools in Latin America, ID/112, United Nations, New York, 1974

All these papers and studies show the problems confronting the developing countries in the development of their metalworking industries and ways in which these problems can be solved.

Taking into account the importance of training local staff from developing countries, UNIDO, in co-operation with the Government of the USSR, is holding an In-Plant Group Training Programme for Engineers in the field of metalworking industry on an annual basis. This Training Programme started in 1969. The duration of each Programme is 4 months and includes theoretical and practical aspects of training. From 1969 to 1974, 90 engineers from 25 developing countries have been trained in the USSR under this Programme.

3. Potential Interest of some Developing Countries of the ECAFE Region for the Development of their Machine Tool Manufacturing Industries

At the beginning of 1974, a UNIDO consultant visited a number of countries of the ECAFE region in order to assess the present and future demands of machine tools and to identify technical assistance required by these countries.

During this mission it was noted that some countries of the region are very interested not only in metalworking but in woodworking machines as well.

Thus, the woodworking industry is also receiving special attention in Malaysia, the Philippines and Thailand as each of these are major timber producing countries and they wish to increase the value of timber exports by undertaking processing to various stages of manufacture before export. As a first step, Malaysia has recently prohibited the export of logs, which must now be sawn before shipment.

Important financial incentives to encourage approved sectors of industry, and machine tools are one of these sectors, to set up and expand are offered by the Governments of Malaysia, the Philippines, Singapore and Thailand.

Potential interest of the countries visited by the UNIDO consultant for the development of their machine tools building industries is shown below, country by country.

PAKISTAN

The Pakistan Machine Tool Factory (PMTF) at Landhi near Karachi is a large modern plant already building machine tools which intends increasing its range, under license agreements and is particularly interested in:

Surface grinders
Cylindrical grinders
Tool and cutter grinders
Special purpose machines of Unit (Modular) Construction

The UNIDO consultant's mission showed that the following Pakistani organisations and factories are interested in UNIDO technical assistance:

PITAC - an expert in heat treatment of specialized tool steels and high speed steel. Facilities available, including induction hardening equipment, but PITAC lacks information on actual steel compositions and can only achieve results by trial and error. Request expert for three months with possible extension. To run a series of courses for private and public sector companies.

PITAC - a tool design expert for a period of six to twelve months to give specialized training to the staff at the Centre.

PECO - a Fellowship in Machine Tool Design for a senior member of their design department in a European organization.

PMTF - a machine tool design expert for six to twelve months to give advanced design training.

PMTF - a heat treatment of automotive gears expert for six weeks to preview the methods of heat treatment in use at the factory, particularly with a view to reducing distortion.

INDIA

India is already a large producer and user of machine tools, with over 100 machine tool manufacturing companies.

Production in 1972	US$53,3 million
Imports in 1972	US$25,0 million
Exports in 1972	US$ 3,5 million

The Government of India wishes to encourage manufacture of machine tools not already built in India and is particularly interested in:

Precision boring and jig boring machines with optical or numerical control systems

Die sinking machines

Thread milling machines

Automatic Bevel gear generating machines

Gear grinding machines

Gear shaving machines

Gear tooth transferring machines

Internal grinding machines - automatic

Slideway grinding machines

India is very much interested in UNIDO technical assistance in:

- setting up a Numerical Control Centre for Metalworking Industry to be attached to the Central Machine Tool Institue (CMTI) in Bangalore. The Centre is expected to accelerate the effective introduction of NC machine tools into local industry; to provide machining services for accurate, complicated and valuable parts; to test for customers the economics of machining by NC; and to provide the advisory service to customers on the selection of NC machine tools.

- assessing the long-range future of the public sector of machine tool industry, with special reference to export possibilities and to organisational problems currently facing Hindustan Machine Tools Ltd. The services of a machine tool expert, capable of taking a long-range view of the potential of the Indian machine tool industry are likely to be requested for 6 months;

- followships for senior machine tool designers to be sent abroad for training for 8 - 12 months.

THAILAND

One company has recently entered into an agreement to manufacture lathes principally for export to the licensor in an industrialized country. The Siam Iron Foundry already exports machine tool castings to the USA. There is considered to be a good local market for the following types of machines, if they are manufactured in the country:

Lathes
Pedestal grinding machines
Bench and pillar drills
Mechanical presses
Shearing machines

PHILIPPINES

A recent survey has identified a substantial demand for lathes and shaping machines. The Machine Tools Manufacturing Company of the Philippines with the co-operation of the Hindustan Machine Tool Co. of India and one other company are planning to manufacture lathes, but a manufacturer of shaping machines is still being sought.

MALAYSIA

The Government is interested in the establishment of a metalworking and woodworking machine tool industry.

The machines in principle demand are:

Centre lathes 12" and 17" swing (300-450 mm)
Bench drilling machines
Column drilling machines
Bench grinding machine (200 mm dia wheel)
Mechanical power press - 20 ton

Woodworking machines:

Band Saw
Circular saw
Combined woodworking machine (surfacing, thicknessing and mortising)

UNIDO is expected to be asked to evaluate the pre-feasibility study report made by Sofi Renault on the development of machine tools in the country.

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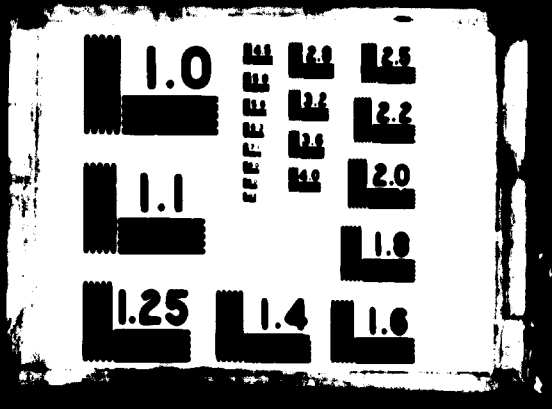


SINGAPORE

The Government has already negotiated the establishment of a number of machine tool and tool making companies in the countries as listed below and is still seeking additional companies.

Company	Country of Origin	Product
Le Blond	USA	Lathes
Cincinnati Milacron	USA	Injection moulding machines
Gebr Hilgeland	FRG	Heading machines
Vollmer Werke	FRG	Saw sharpening and servicing machines
Pittler	FRG	Auto lathes
Okamoto	Japan	Surface and internal grinding machines
Koyo Seiko	Japan	Bearings and machine tools
Patience and Nicholson	Australia	Twist drills and cutting tools
Tata	India	Precision tools and dies

BANGLADESH

The Government of Bangladesh is interested in a UNIDO technical assistance to be provided to the Bangladesh Machine Tool Factory in the field of management. UNIDO assistance is also required to BITAC in mould and die design.

ANNEX

This Annex contains samples of typical job descriptions for UNIDO experts. These job descriptions might form a basis of a request for assistance under the SIS programme in any of the following fields:

1. General survey of metalworking industries
2. General survey of machine tools
3. Selection and utilisation of machine tools
4. Maintenance and repair of machine tools
5. Development of tools, dies, jigs and fixtures
6. Introduction of welding techniques
7. Introduction of NC machine tools

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNITED NATIONS DEVELOPMENT PROGRAMME

Request from the Government of *.....

for Special Industrial Services 1/

Job Description

POST TITLE:	Expert to carry out a general survey of the metalworking industry
DURATION:	Six months with possible extension
DATE REQUIRED:	As soon as possible
DUTY STATION:	*
PURPOSE OF PROJECT:	To assist the Government in making general surveys of metalworking industries in the country and to study the possiblity of the establishment of a Metalworking Industrial Design Development Centre (MIDC).
DUTIES:	The expert, in collaboration with local officials, is expected to: a. study the existing situation in the field of the design and production of dies, jigs, tools and other related industrial equipment in the metalworking industry; b. formulate and recommend a long-term programme for the development of the metalworking industry; c. study the possiblity of the establishment of a Metalworking Industry Development Centre which will serve the local industry in improving of the quality of production.
QUALIFICATIONS:	Mechanical engineer with experience in metalworking industry.
LANGUAGE:	*
BACKGROUND INFORMATION:	The UNIDO Meeting of Experts/Decision Makers for Promotion and Development of Machine Tool Industries in Developing Countries of Asia and the Far East, held in 1974, stressed the importance of the development of metalworking industries in the countries of the region. The Government is requesting UNIDO technical assistance in the establishment of a Metalworking Industry Development Centre. The purpose of the Centre is to identify product lines to be developed or to be adopted; design and prototype production, quality control, testing and cost analysis; the development of manufacturing techniques and processes; the selection, development, utilization, maintenance and repair of machine tools and instruments, to provide technical services to local industries in the design and development of specific products.

NOTE: It is desirable that the Government should supply additional information on the status and plans for the industry.

1/ Request to be submitted through the UNDP Resident Representative residing in the respective country.

* To be completed by the Government

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNITED NATIONS DEVELOPMENT PROGRAMME

Request from the Government of *.....

for Special Industrial Services 1/

Job Description

POST TITLE: Expert to carry out a general survey of machine tools

DURATION: Six months with possible extension

DATE REQUIRED: As soon as possible

DUTY STATION: *

PURPOSE OF PROJECT: To assist the Government of * in the assessment of the stock of machine tools in the country, taking into consideration the development of metalworking and other industries.

DUTIES: The expert, in co-operation with the respective government body will be expected to:

a. study the existing stock of machine tools and the plans for metalworking and other industries;

b. investigate the demand, production, import and possible export of machine tools;

c. select machine tools by types to be imported and/or produced;

d. recommend future UNIDO long term assistance in this field.

QUALIFICATIONS: Industrial engineer or economist with experience in the machine tool industry

LANGUAGE: *

BACKGROUND INFORMATION: The UNIDO Meeting of Experts/Decision Makers for Promotion and Development of Machine Tool Industries in Developing Countries of Asia and the Far East, held in 1974, stressed the importance of availability of machine tools for industrial development. The Government decided to study the existing stock of machine tools in the country and to discuss the kind of equipment required for the successful development of local industries. UNIDO technical assistance is requested in order to make general surveys of the machine tools available in the country.

NOTE: It is desirable for the Government to supply additional information on the status and plans for the industry.

1/ Request to be submitted through the UNDP Resident Representative residing in the respective country.

* to be completed by the Government

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNITED NATIONS DEVELOPMENT PROGRAMME

Request from the Government of *...../.....
for Special Industrial Services 1/

Job Description

POST TITLE: Expert in the selection and utilization of machine tools

DURATION: Six months with possible extension

DATE REQUIRED: As soon as possible

DUTY STATION: *

PURPOSE OF PROJECT: To assist the Government of * in the selection and utilization of machine tools, through an evaluation of the production lines.

DUTIES: The expert is expect to assist local enterprises to:

a. examine machine tools by size and type through an evaluation of the production lines;

b. identify the causes of the underutilization of machine tools;

c. make recommendations on the proper selection and use of machine tool in order to increase productivity and improve the quality of production;

d. train local personnel in proper utilization of machine tools.

QUALIFICATIONS: Mechanical engineer with experience in utilization of machine tools

LANGUAGE: *

BACKGROUND INFORMATION: The UNIDO Meeting of Experts/Decision Makers for Promotion and Development of Machine Tool Industries in Developing Countries of Asia and the Far East, held in 1974, noted an approximate 50% utilisation of the machine tools in the countries of the region. This underutilization causes unnecessary expenditure and an increase in the stock of machine tools requiring additional servicing, maintenance and repair. The Government is requesting UNIDO technical assistance in order to improve the situation concerning underutilization.

NOTE: It is desirable for the Government to supply additional information on the status and plans for the industry.

1/ Request to be submitted through the UNDP Resident Representative residing in the respective country.

* To be completed by the Government.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNITED NATIONS DEVELOPMENT PROGRAMME

Request from the Government of *.....

for Special Industrial Services[1]

Job Description

POST TITLE:	Expert in maintenance and repair of machine tools
DURATION:	**Six months with possible extension**
DATE REQUIRED:	As soon as possible
DUTY STATION:	*
PURPOSE OF PROJECT:	To assist the Government of * in the organization of services for the maintenance and repair of machine tools.
DUTIES:	The expert will be attached to the Government organization and is expected to:
	a. study the existing maintenance and repair services for machine tools;
	b. make recommendations on means of improving these services;
	c. study the possibility of the establishment of a machine tool re-building centre;
	d. train local personnel in the maintenance and repair of machine tools.
QUALIFICATIONS:	Mechanical engineer with experience in the maintenance and repair of machine tools
LANGUAGE:	*
BACKGROUND INFORMATION:	The UNIDO Meeting of Experts/Decision Makers for Promotion and Development of Machine Tool Industries in Developing Countries of Asia and the Far East, held in 1974, stressed the importance of establishing proper maintenance and repair services for machine tools. In order to keep equipment in permanent working order with the minimum expenditure of time and resources, it is necessary to institute a repair and maintenance system in the country. Realising the importance of such a project, the Government is requesting UNIDO technical assistance in the field of maintenance and repair.

NOTE: It is desirable for the Government to supply additional information on the status and plans for the industry.

1/ Request to be submitted through the UNDP Resident Representative residing in the respective country

* to be completed by the Government.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNITED NATIONS DEVELOPMENT PROGRAMME

Request from the Government of *.....

for Special Industrial Services 1/

Job Description

POST TITLE: Expert in Tools, dies, jigs and fixtures

DURATION: Six months with possible extension

DATE REQUIRED: As soon as possible

DUTY STATION: *

PURPOSE OF PROJECT: To assist the Government of * in the development of the local production of tools, dies, jigs and fixtures.

DUTIES: The expert, in collaboration with the respective Government department, wil be expected to:

a. study the requirements of the country in tools, dies, jigs and fixtures;

b. assist in the design, adaptation, and production of tools, dies, jigs and fixtures;

c. make recommendations on the choice and use of the correct materials for tools and dies;

d. study the possibility of the establishment of a centre for the design and prototype production of tools and dies;

e. train local personnel in the use of modern technology for the production of the above mentioned tools.

QUALIFICATIONS: Mechanical engineer with extensive experience in research design and production of tools, dies, jigs and fixtures.

LANGUAGE: *

BACKGROUND INFORMATION: The Government has decided to develop its local tool producing industry, including the production of tools, dies , jigs and fixtures. Realising the importance of establishing an independent centre with modern equipment for the manufacture of tools, dies, jigs and fixtures, their heat treatment and inspection, the Government is requesting UNIDO technical assistance for the project. It is expected that the Centre will train local personell in the design and production of prototypes and in the use of dies, moulds, jigs and fixtures.

NOTE: It is desirable for the Government to supply additional information on the status and plans for the industry.

1/ Request to be submitted through the UNDP Resident Representative residing in the respective country.

* To be completed by the Government.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNITED NATIONS DEVELOPMENT PROGRAMME

Request from the Government of *.....

for Special Industrial Services 1/

Job Description

POST TITLE:	Expert in welding techniques
DURATION:	Six months with possible extension
DATE REQUIRED:	As soon as possible
DUTY STATION:	*
PURPOSE OF PROJECT:	The Government wishes to develop the welding and brazing facilities in the country.
DUTIES:	The expert is expected to: a. study the possibility of the development of welding by local enterprises; b. select welding equipment for local use; c. transfer the technological process to local enterprises; d. advise on the proper utilization of welding equipment; e. study the possibility of establishing a welding centre; f. train local personnel.
QUALIFICATIONS:	Mechanical engineering in welding, with considerable experience in the field of the organization of welding works and the carrying out of feasibility studies.
LANGUAGE:	*
BACKGROUND INFORMATION:	Welding is a simple and cheap process of joining and cutting parts of machines. It can be of great use to developing countries in maintenance and repair as well as in the production of industrial, agricultural and transport equipment. As it is possible to produce welds with the same mechanical properties as the base material, welding is used extensively throughout industry. This technique reduces the weight of equipment and increases production. The process is simple, does not require highly qualified personnel and can be undertaken by any country.

NOTE: It is desirable for the Government to supply additional information on the status and plans for the industry.

1/ Request to be submitted through the UNDP Resident Representative residing in the respective country.

* to be completed by the Government

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNITED NATIONS DEVELOPMENT PROGRAMME

Request from the Government of *..... ....

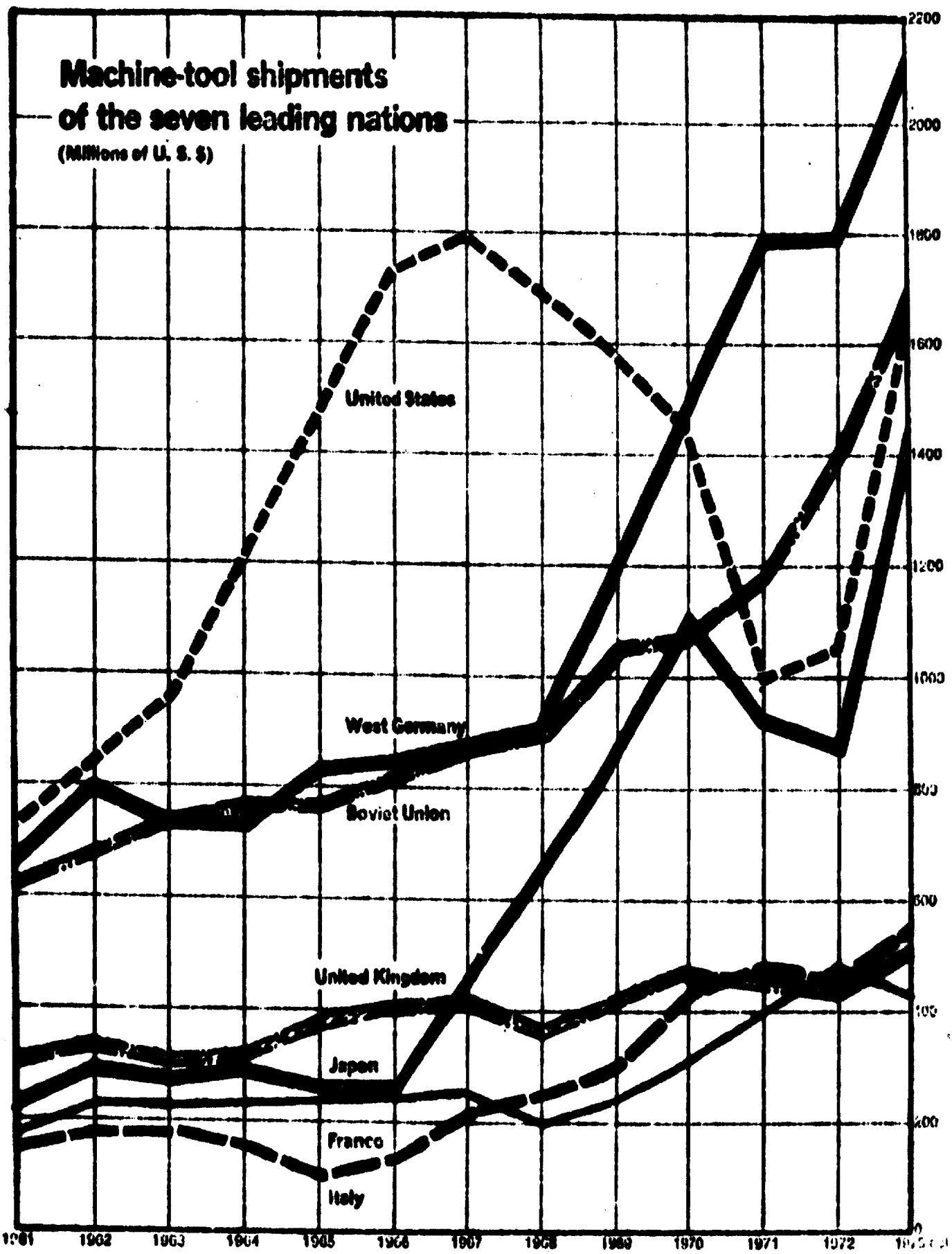
for Special Industrial Services[1/]

Job Description

POST TITLE:	Expert in numerically controlled machine tools
DURATION:	Six months with possible extension
DATE REQUIRED:	As soon as possible
DUTY STATION:	*
PURPOSE OF PROJECT:	To assist the Government of * in the introduction of numerically controlled (NC) machine tools in the metal-working industries of the country, through an evaluation of the product lines.
DUTIES:	The expert is expected to assist local manufacturers to: a. study the possibility of the introduction of NC machine tools; b. examine the possibility of the establishment of a NC Machine Tool Demonstration Centre; c. prepare a list of experts and equipment required for the activities of the Centre; d. identify the availability of local staff for employment by the Centre and participation in its training programme.
QUALIFICATION:	Mechanical or electrical engineer with experience in NC machine tools.
LANGUAGE:	*
BACKGROUND INFORMATION:	Difficulties in metalworking could be settled to a certain extent, by the introduction of NC machine tools. The main advantages of NC which may be considered relevant in the country are: - the improvement of quality - the elimination of jigs, fixtures and other expensive tooling, as well as the consequent reduction in setting up time; - the reduction of inspection and measuring instruments; - greater accuracy and better reproduction; - substantial reduction in human errors; - the possibility of using less skilled operators. In order to introduce modern techniques and to allow production engineers to see the practical application of NC under production conditions, to provide an advisory service on the selection of NC machine tools, the Government is requesting UNIDO technical assistance in studying the possibility of introducing NC into the country.

1/ Request to be submitted through the UNDP Resident Representative residing in the respective country.

* to be completed by the Government



Source: American Machinist

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