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Regional Seminar on Machine Tools
in Developing Countries of
Europe and the Middle East

Slatni Pjassazi (Golden Sands) near Varna,
Bulgaria, 18 to 27 October 1971

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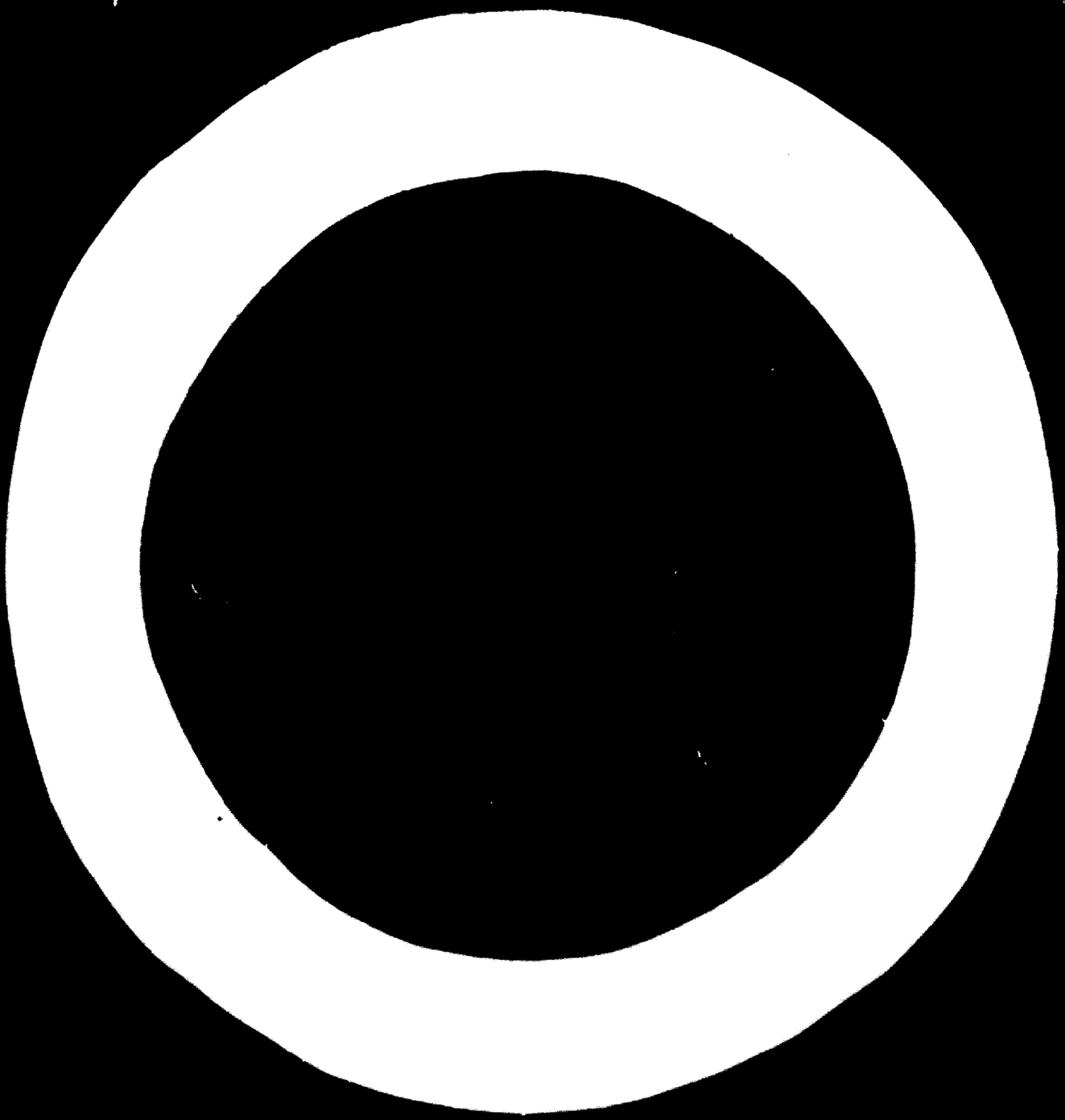

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INTRODUCTION

The Regional Seminar on machine tools in the developing countries of Europe and the Middle East was held in Varna, Bulgaria from 18th to the 27th October, 1971 under the sponsorship of the United Nations Industrial Development Organization in co-operation with the Bulgarian Government Ministry of Machine Building. The Seminar was attended by ----- participants from ----- countries, by staff members and consultants of the United Nations Industrial Development Organization, the Economic Commission for Europe and by members of the European Committee for Co-operation of Machine Tool Industries (CECIMO).

An address of welcome to all participants in whatever capacity they were attending was given by -----. Following the inaugural address the meeting elected Mr. ----- as Chairman and Mr. ----- as Vice Chairman and finally elected Mr. ----- as Rapporteur of the meeting. The Chairman gave his opening address and this was followed by the members of the Seminar approving the Agenda. The Committee to draft the report of the Seminar was then appointed consisting of ----- ----- ----- ----- ----- members.

The purpose of the Seminar was to provide (through the presentation of papers, films/discussions and factory visits) the comprehensive review and analysis of the technical and economic problems concerning the establishment and development of a machine tool industry in the developing countries. ----- papers from international experts of established reputation in their respective fields, together with ----- papers prepared by UNIDO were presented. After the presentation of each paper, intensive discussions took place on the application of the subject matter to the needs of the developing countries in general and to the specific requirements of the

participants and their countries.

In addition to the presentation of the papers and to the discussions thereon, visits were arranged by courtesy of the Bulgarian Government to machine tool building plants in Kasanlak, Asenovgrad and Pazardjik to study the production and utilization of machine tools under workshop conditions. Visits were also made to the Z.D.M. factory in Plovdiv to study the production of woodworking machines; also to the Z.D.M. in Sofia to observe the production of metal cutting machine tools.

The report of the Seminar was approved and adopted at the afternoon meeting on Friday, 22nd October, 1971. The closing address for the Seminar was delivered by the Chairman, Mr. _____ .

CONCLUSIONS

From the papers presented by the experts at the Seminar, from the country study reports and from the general discussions which followed the presentation of papers, when matters of great interest were reviewed, the following general conclusions can be drawn:

Industrial Growth

The growth of machine tool using industries is one of the most important factors in the development of industry and of the increase of national income and employment of developing countries.

Stages of Development

A country developing its metal working industry appears to go through three typical stages: The first stage, during which installation, maintainance and repair of metal working machines and also of other types of machine for other industries takes place. The second stage of which some manufacturing of metal working machines is carried out, mainly for local consumption, and the third stage in which complicated machines are produced, not only for local use but also for export to other developing countries and ultimately to the highly industrialised countries of the world.

It is also noted that the problems of the developing countries vary as different stages of their metal working development take place. It is therefore not feasible to submit one formula for all developing countries. For instance, in those countries which are still in the first stage the most pressing problems may be more organisational than technical. When considering the conditions necessary for establishing machine tool industries the background and stage development of the country concerned must be carefully examined. Co-operation with the industrialised

countries may enable the developing countries to by-pass many trial stages. The acquisition of manufacturing drawings and "know-how" are typical examples.

Machine Building

Machine building projects must be viewed as part of a general plan for industrialisation. The government may set up their own factories for machine building or it may encourage free enterprise to do so or possibly a combination of these arrangements. The newly established machine tool industry will be in an economically precarious position which may justify some form of government protection. It is however important that the industry should become economically viable as rapidly as possible as prolonged protection can lead to stagnation and inefficiency which will be damaging to the metal working industry of the country as a whole.

Use of Numerical Controls

The introduction of numerically controlled machine tools in a developing country presents many peculiar problems. Two classes of specialist must be trained before such machines can be effectively utilised in a country:

(a) Programmers to prepare the necessary machine programme and input tape that will provide the commands for the machine control unit.

(b) Service engineers capable of servicing the electronic control systems used on the machines.

The advantages of these machines however are so great that every effort should be made to achieve the early introduction of these machines into the machine tool manufacturing companies where flexibility of

manufacture is of paramount importance. The procurement of jigs and fixtures for the comparatively small batch production which is an inherent characteristic of the machine tool industry is a time consuming and costly exercise. Many of these jigs and fixtures can be eliminated or greatly simplified when a numerically controlled machine is used and it is therefore possible to commence manufacture of a new model of machine much more rapidly than would otherwise be the case.

Regional Trading Agreements

Although it is normal to produce machine tools in relatively small batches it is necessary from an economic viewpoint that continuity of production of each model should be achieved. This can only occur where there is an adequate market which will seldom exist in the smaller developing countries. Trading agreements with neighbouring countries are therefore highly desirable so as to create a higher demand potential for each model of machine that is included in the production programme.

Management Incentives

The development and running of a machine tool industry requires a very highly specialised management team which is not easily recruited. Making optimum use of the few experts available in developing countries is therefore of paramount importance. Sufficient incentive for these experts must be provided so that the brain drain to developed countries can be prevented. The recruitment of sufficient personnel at the technician and skilled worker level should also be considered during the planning stage so that suitable trainingfacilities can be set up and an adequate training programme implemented.

Design and Development

In the initial stages the types of machines which are to be manufactured should be of a simple or an elementary kind. The developing

country should not be content to continue indefinitely with these types of machines and once the intricacies of machine tool manufacturing have been mastered machines of a more sophisticated nature should be introduced into the manufacturing programme. If the developing countries are to contribute high quality metal working machines to the world market, modern practical and technically shound designs will have to be adopted. Until a very advanced stage in the development of the machine tool industry is reached, it may be desirable that designs from industrialised countries should be obtained, either through licence agreements or through partnership arrangements, keeping in mind that changes in environment may necessitate modifications.

Market Research

The introduction of a new model of a machine tool is an extremely costly affair and it is therefore of great importance that the model should meet the market requirements in every respect and that the potential demand should have been accurately assessed. Market research for capital goods is one of the most difficult operations to carry out successfully so the need to use staff with a wide experience of machine tool marketing, together with the techniques employed in market research for capital goods, is essential if reliable results are to be obtained.

RECOMMENDATIONS

Resulting from the deliberations which took place at the Regional Seminar on Machine Tools in the Developing Countries of Europe and the Middle East, the participating members submit to the United Nations the following recommendations for action to be undertaken by the developing countries, by industrially advanced countries and by the United Nations, either individually or jointly:

1. Each developing country should establish a Metalworking Industry Development Centre. This should have responsibility to provide information to the metal working industry of the country of the most suitable methods of machine information of the latest manufacturing techniques and sources of suitable machines. Where a suitable body already exists it may be preferable to set up the information as a section of the existing organization. It must, however, be staffed by adequately trained personnel who will be able to relate the available techniques and suitability of machines to the local industry requirement. The provision of a United Nations expert to assist with the initial establishment of such a centre would be invaluable.

2. The adoption of acceptance standards for machine tools appropriate to the national requirements should be arranged. These may be up-dated Slessenger standards or other suitable internationally acceptable standards. Standards for components and other relevant items should also be established. In most countries a suitable body to undertake this work already exists, but a specific department with responsibility for machine tools should be set up.

Assistance to the developing countries should be given both by the industrialised countries and by the United Nations.

3. The collection and publication of detailed statistics is essential to the industrial development of a country. The developing countries should review the statistical service they provide to their industry and make such improvements to this service as seem necessary in the light of the findings of the review. It should be borne in mind that speed is as important as accuracy. In fact it may even be desirable to sacrifice some degree of accuracy to achieve early publication of vital statistics.

4. Improved market research will prevent many extremely costly mistakes being made by developing countries through the introduction of unsuitable machines, or through the planning of production greatly in excess of the demand. The United Nations should provide an expert to the developing countries to assist with establishing in each country an organization capable of undertaking reliable market research in the capital goods field and especially relating to machine tools.

5. Every developing country which sets up its own machine tool manufacturing industry will ultimately find it essential to undertake a degree research and development on its own account. Delay in accepting this responsibility will only bring increasing dependence on the goodwill and favours of other countries. The industry should run its own research and development unit, either on a central industry basis or servicing individual companies. This should be undertaken even where all the machines in current production are manufactured under foreign licence and "know-how"

agreements. The centre would have responsibility for adapting established products to meet local market requirements as well as assisting the understanding of basic machining principles. Ultimately development of machines to their own specification and design may become desirable. Both the United Nations and the industrialised countries should assist developing countries in this work.

6. The developing countries should review carefully the adequacy of their training facilities covering their requirements from craft training to graduate integration into industry schemes. The effectiveness of the training given will play a major part in controlling the success of the industrial development progress of the country.

7. The developing country should make concentrated efforts to develop the skills necessary for the manufacture of jigs and fixtures. The development of skills should be attempted at all levels starting from machine operators, technicians, designers and up to technical manager. The United Nations should assist developing countries, where necessary, with the provision of experts for carrying out this programme of training.

8. Preventative maintainance programmes should be introduced in all the larger industrial establishments. The governments of the developing countries should set an example by establishing the programmes in plants directly under their own control. Extensive education will be required to ensure the success of such programmes. These are not easily set up so that special assistance should be given by the United Nations to start the programmes on lines which will lead to success and reduced machine breakdown.

9. The developing country should consider whether there are adequate facilities within that country for the re-building of machine tools which have ceased to operate efficiently. In many instances it will be desirable to have a centre for the specific purpose of re-building machine tools. In the countries with little industrial development assistance from an industrialised country or from United Nations will be necessary.

10. In some of the developing countries there is an acute lack of information concerning facilities for supply or manufacture of components from facilities which are already established within the country. Wide dissemination of information of facilities available would assist inter-trading between companies, thereby improving productivity by encouraging companies to specialise. The United Nations should provide experts to assist developing countries to set up a 'Sub-Contract Exchange Bureau' where information on manufacturing and specialist component facilities could be maintained and disseminated to all interested parties.

11. The United Nations should initiate an educational programme to bring to the attention of the developing countries the advantages which would accrue from the use of numerically controlled machine tools in small scale production. They should also assist with the organisation training programmes for programmers and service engineers for the electronic control systems.

Taking into account the different levels in development of the metalworking industries in the countries of the region, the recommended steps to be taken are given individually as follows:

FOR DEVELOPING COUNTRIES

TURKEY

(a) Give more attention to the establishment of machine tool standards in the country;

(b) Study the requirements of tools, dies, jigs and fixtures in order to establish a centre with modern equipment for their development, research and design.

ARAB REPUBLIC OF EGYPT

(a) Train local personnel in the field of machine tool building and tool making industry;

(b) Establish a national institute or centre for research and development of machine tools which would serve the whole industry in the selection, design, design adaptation, production, utilisation, rebuilding, and maintenance and repair of machine tools.

ISRAEL

(a) Train local personnel in utilisation and application of N. C. Machine tools;

(b) Give more attention to the proper selection of machine tools used for production purposes.

IRAN

(a) Study the possibility of establishing a plant for the production of metalcutting tools;

(b) Give more attention to the problems of proper utilisation and repair of machine tools.

SYRIA

(a) Study the existing park of machine tools as to its quantity, quality, type and age;

(b) Investigate the possibility of establishing a machine tool rebuilding centre.

JORDAN

(a) Study the existing stock of machine tools, their quantity, quality, type and age;

(b) Select machine tools properly by types, through evaluation of production lines;

(c) Give more attention to the problems of full utilization of machine tools, and their maintenance and repair.

KUWAIT

(a) Study the existing machine tools in the country, their number, quality, age and type, in order to discuss what machine tools could be imported for local industry;

(b) Pay more attention to the problems of utilization, maintenance and repair of machine tools and their accessories.

PEOPLES DEMOCRATIC REPUBLIC OF YEMEN

(a) Study the existing machine tools, their quantity, type, age and quality in order to select new ones if necessary;

(b) Give more attention to the problems of proper utilisation, maintenance and repair of machine tools, dies, jigs and fixtures;

(c) Study the possibility of establishing a centre for the production of hand tools (pliers, spanners, pincers, hammers, etc).

YEMEN ARAB REPUBLIC

(a) Make a general survey of the existing stock of machine tools;

(b) Give more attention to the proper selection and utilisation of machine tools, dies, jigs and fixtures.

FOR DEVELOPED COUNTRIES:

It is recommended that the following steps be taken:

(a) Provide technical assistance to the countries of the Region in the fields of selection, production, utilization, maintenance, repair and rebuilding of machine tools, by supplying experts for the training of local engineers and technicians;

(b) Accept trainees from developing countries;

(c) Supply information relevant to the development and application of machine tools in these countries;

(d) Co-operate with UNIDO in providing technical assistance in this field.

FOR UNIDO

UNIDO should

(a) make expert assistance available to the countries to enable proper machine tools surveys to be conducted;

(b) provide technical assistance to the countries of the Region in the selection, application, maintenance and repair and other aspects of machine tools.

(c) Provide technical assistance in the establishment of metalworking industries development centres, machine tool rebuilding centres, tool and die development centres or institutes related to the metalworking industries.

(d) Co-operate with CECIMO and other machine tool manufacturers' associations in order to provide technical assistance .

ECONOMIC IMPORTANCE OF THE METAL WORKING INDUSTRY

Metal working industries account for almost 30% of the world's industrial production measured in terms of value added. Among the major branches of industry metal working assumed the greatest increase in production during the past thirty years. This increase has been more significant in the developing countries than in industrialised ones. Nevertheless, the share of the developing countries in the total production of metal products was only 3.9% in 1958 and was the lowest among all major branches of industry. The relative importance of the metal working industries may be assessed in terms of their percentage share in the total manufacturing output, their contribution to employment and the value added in the process of manufacture. In the industrialised countries the percentage production of machinery and industrial equipment of the total industrial output may be as high as 40%, whereas in the developing countries it is only 5% or 10%.

Significance of the Machine Tool Industry

Within the metal working industry the machine tool industry plays a key roll in the expansion of world industrial production, since nearly all other products are manufactured by machine tools or by machinery that has been produced with such tools. This is true for items regardless of their size, for items as diverse as a cigarette lighter, surgical instruments, typewriter, washing machine, armaments, agricultural machinery, giant aeroplanes and the ubiquitous automobile could not be produced without machine tools. Nations with highly developed metal working industries enjoy the higher standards of living, therefore the industrial development of a country depends to a considerable degree on number, age, quality and type of machine tools which it possesses. It is impossible to study the history of technology without becoming aware

of the crucially important part played in that history by machine tools. It is no exaggeration to say that man's tools have governed the pace of industrial development. We should never have heard of James Watt, George Stevenson, Gottlieb Daimler, Rudolf Diesel or the Wright Brothers but for the tools which alone enabled their inventions to be manufactured. Throughout history the rate of man's material progress has been determined by his tools, because all tools represent synthetic extensions of the human hand being designed to magnify its skill or its power. When that hand first used a tree branch as a lever or a stone as a hammer an evolutionary process began which has led logically to the fully automatic power controlled machine tool of today. The accelerating demand for machine tools in a highly industrialised country is shown by the table below for the United States during the decade 1958 to 1968. From this table it will be seen that while the gross national product did not quite double during the period, the machine tool demand actually trebled.

THE U.S.A. NATIONAL ECONOMY AND MACHINE TOOLS

Calendar Years, 1958 to 1968

		Shipments in Billion Dollars			Shipments in Million Dollars
Year	GNP Billion $	All Manufacturing Industries	Durable Goods Industry	Non-Electrical Machinery Industry	Complete Machine Tools
1958	$447.3	$326.7	$162.9	$22.8	$ 591
1959	483.7	369.1	186.5	25.7	616
1960	503.7	368.7	185.8	25.8	744
1961	520.1	373.0	186.5	25.7	751
1962	560.3	396.1	205.2	28.3	821
1963	590.5	423.9	219.0	30.4	896
1964	632.4	448.0	235.6	35.1	1,164
1965	684.9	492.0	266.6	39.2	1,426
1966	747.6	538.5	295.6	46.7	1,685
1967	789.7	548.5	299.7	52.1	1,806
1968	860.6	603.7	331.0	58.0	1,727

Source: National Machine Tool Builders' Association

. . .

Due to the great variety and complex nature of machine tools, not even the most developed country can produce the required number and maintain the necessary technical level for the design of all types of machines required by the metal working industry of the country. It is therefore necessary to purchase certain of these machines from other countries. Initially the production of machine tools in a particular country should be limited to those types of machines and associated equipment that are necessary for the growth of the leading branches of its economy. It is impractical to give a generalised answer as to what priorities are to be assigned to single branches of the economy in the process of industrial growth of a developing country. Every case has to be analysed and investigated separately and several methods of approach are possible. From the viewpoint of the entire national economy of a country the main criteria for the choice are based on the resources to be allocated to investment, of foreign exchange earnings and expenditures and on manpower resources. The capital intensity of the metal working industries as a whole is near the average of all types of manufacturing. The foreign exchange effect depends largely on the proportion of domestic raw materials used. Where indigenous production of raw materials is substantial, the metal working industry can rank high in foreign exchange earnings or savings. It should also be noted that the metal working industries are labour intensive. In developing countries this is generally considered an advantage and is certainly not outweighed by the high demands on the skills and education of the labour force. The typical structure of the engineering industry in industrialised countries with approximate percentages for individual branches is as follows:

Simple metal products	6%
Electrical machinery	24%
Non-electrical machinery	33%
Transportation equipment	33%
Instruments, watches and clocks	4%
	100%

In the early stages of industrialisation of a developing country, where the engineering industry has already been developed, the share of simple metal products is substantially higher and may be as much as thirty per cent. A downward trend however becomes apparent as the engineering production increases.

World Machine Tool Production

The production of machine tools throughout the world during the period 1961 to 1970 is given below:

Country	In million Swiss francs				
	1961	1964	1966	1968	1970
Western Europe (CECIMO)	7,032	7,785	8,642	9,164	13,549
U.S.A.	3,420	5,222	7,472	7,551	6,384
U.S.S.R.	2,800	3,454	3,386	3,900	5,181
Japan	1,000	1,332	1,117	2,846	4,804
D.D.R.	650	689	743	949	1,202
Czechoslovakia	570	883	1,005	1,014	1,071
Poland	205	234	275	372	538
Hungary	125	118	144	166	219
China	340	306	-	197	219
Canada	60	104	135	120	173
Australia	65	66	140	123	131
India	88	192	275	121	210
Argentina	115	70	80	99	142
Brazil	80	136	140	124	98
Others	294	197	481	245	353
Total estimated world production	16,844	20,788	24,035	26,991	34,280
CECIMO % of world production	42%	37.5%	36%	34%	39.5%

In 1961 production of machine tools was principally concentrated in the member countries of CMCIMO, the U.S.A. and the U.S.S.R. and these accounted for more than 80% of the total world machine tool production. By 1970 total world production had more than doubled reaching 34,280 million Swiss francs. While the three principal manufacturers of machine tools had also increased their production considerably, their percentage of the world total had fallen to just below 75%. This change was principally brought about by the rapid increase in machine tool production in Japan, where production had remained almost static between 1961 and 1966, but since then more than quadrupled, reaching 4,804 million Swiss francs in 1970. Most of the other producing countries also had fairly large increases but these were mostly in line with the general level of world production. The one notable exception was the case of China where production apparently fell from 340 million in 1961 to 173 million Swiss francs in 1970.

The principal producing countries export a high percentage of their production, surprisingly the greatest part of these exports go to other major machine tool producing countries and only a comparatively small percentage to the non-machine tool producing countries of the world. The latest export figures for the principal countries are given below:

Exports 1970

Country	In million Swiss francs
Austria	125,055
Belgium	131,175
Switzerland	852,645
Germany	3,464,363
Denmark	58,999
Spain	117,600
France	497,493
Great Britain	850,459
Italy	825,536
Netherlands	52,470
Portugal	5,247
Sweden	193,704
Total CECIMO	7,174,746
U.S.A.	1,355,487
U.S.S.R.	467,062
Japan	397,464

Geographical distribution of exports by CECIMO Members

Destination	1969
Other CECIMO countries	42%
Other European countries	3%
Eastern Europe	21%
Africa	3%
North America	11%
South America	6%
Asia	12%
South East Asia	2%

The high volume of exports is perhaps the clearest indication that not even the most industrialised countries of the world attempt to produce all the types of machine tools which are required by the industry in their country. The more sophisticated types of machine tools are extremely costly to develop and require a large specialised team with an intimate knowledge of the particular manufacturing requirements of their customers, as well as a complete understanding of the latest machine tool technology and manufacturing techniques. It is not sufficient to develop a machine which in itself may be far in advance of its competition because technology is advancing so rapidly that continuous up-dating of the design will be necessary. The successful company producing advanced types of machine tools not only requires to maintain this highly specialised team engaged in the design of the machines but also requires a further specialised team. This second team is responsible for the continuous development of tooling arrangements to obtain the most effective output from the machine itself. Their work is intimately associated with that of the design team, but of necessity they must work even more closely with the customer and they are usually entrusted with the responsibility for designing the tooling required to produce the customer's particular components. The production manager of a company in the metal working industry today seldom gives a specification for the machine which he wishes to purchase, but will provide the prospective suppliers of the machinery with drawings of the components which they wish to produce, specifying the number required per week and the proposed numbers of hours per week which the machine will be operated. The machine tool manufacturer is then entrusted with the responsibility for deciding on the most efficient method of machining the component and will submit his quotation for the machine together with all the special tooling which will be required. Detailed estimates of production times

will be given together with estimated tool life and changeover time where more than one component is being produced. When the machine has been completed at the builder's plant the customer will supply a number of forgings or other pieces of blank material for proving out the machine capability. Only when the machine has been demonstrated to the satisfaction of the customer and the production estimates and tool life estimates have been proved will delivery be effected.

The manufacturer of the simpler machines does not, of course, require to maintain these large specialist teams and the customer on his part will expect to buy a machine on its own specification rather than on the basis of a guaranteed production estimate. The work undertaken on the machine is likely to be of a much wider range than in the case of the specialist machine and the operating conditions are likely to be much less rigidly controlled due to the totally different environment in which the machine will operate. The design of the simpler basic type of machine inevitably remains much more static as they are not subject to the same rapid technological progress applying to the more sophisticated machines and this means that the same model will remain in production for much longer periods of time. As development is comparatively slow only a small engineering department will be required to make the essential modifications and up-dating of the design from the successful original design. This design may either have been developed locally or obtained under a licencing agreement from a company in one of the more industrialised countries. These simpler general purpose type machines are much easier to manufacture than their more sophisticated counterparts. This is due to a number of reasons, which must be briefly considered. The production runs of each model are much longer so that greater use of jigs and fixtures is justified. Complicated electronic or hydraulic systems are not required

as sequential control or other inter-related functions are not necessary. Individual parts are simpler as there is less need for compact design. Parts are less highly stressed so that less accuracy is required and difficult heat treatment operations are eliminated. Finally, but by no means least, the fitters building the machines become fully familiar with the design and are therefore very proficient in completing their particular task.

The increasing costs in industrialised countries is leading them to concentrate on the more sophisticated type of machines where there is less price competition and the expenses of their research and development programmes, together with the staffs of highly qualified people can be adequately covered. Due to the great variety of types of machine tools they have not lent themselves to mass production so that with a few notable exceptions high production techniques and line assembly have not been adopted. This is creating an opportunity for countries whose labour costs are relatively low to sell machine tools, not only on their home market and in adjacent developing countries, but also in the highly industrialised countries where there is a very large market in the smaller companies and service workshops for simple types of machine tools. The quality and accuracy of these machines must be however of a very high standard, but this can be achieved without undue difficulty provided sound principles are followed when first starting manufacture and the basic criteria for efficient quality control are applied rigorously. These opportunities do not yet seem to have been adequately exploited and there could therefore be worthwhile rewards to the country which carries out an efficient market research programme to ensure that the product they manufacture meets the widest possible potential in a number of countries. It must then establish an efficient plant to build the machines economically within the laid down quality limits where the most up-to-date manufacturing methods are used, together with all the equipment necessary for reliable

quality control both for dimensional accuracy and for metallurgical quality. When a consistently good quality product can be achieved a vigorous marketing campaign will be necessary using local agents in overseas countries. The selling operation must be fully supported by efficient service and spare part supplies.

Education and Training of Manpower

The relative shortage of technical manpower in the developing countries which have little or no manufacturing tradition is often acute. In most of these countries, technical education and vocational training are organised by the government and persons receive their education locally or abroad at public expense. The metal working industry is often very low on the priority list of trained manpower and receives only a small part of its real needs.

There seems to be a tendency in the metal working industries also to draw managerial personnel from indigenous persons who are orientated towards marketing. Such managers often face a difficult period of adjustment as they try to cope with many of the multiple responsibilities in the technical and manufacturing field which they must assume in addition to sales promotion. One of the main difficulties encountered in the training of managerial and technical personnel who study in the industrially advanced countries is that the skills and points of view acquired are often too sophisticated for the application in the setting which includes obsolescent machinery, short supplies of material, non-discriminating customers and technicians of limited experience, coupled with unskilled shopfloor labour. Such circumstances are often frustrating to the newly trained engineer or scientist and along with the lure of higher salaries account for the reluctance of some trained personnel to return to their own countries when their studies abroad are complete.

An alternative method of developing skills is to encourage foreign manufacturers of engineering products to set up plants which are especially designed for local requirements and fitted to the capabilities of the local labour force. Such arrangements can provide the required designs, manufacturing techniques and supervisory manpower which will enable production to commence rapidly and to expand steadily. Foreign specialists and foreign designs can then gradually be replaced as indigenous technical supervisory talent develops.

Contrary to popular belief, automated processes and equipment can bring a net gain to developing countries, to both their economic and social development. This gain occurs when the packaged intelligence of an automated device could be an inexpensive supplement providing reduction of control skills which would otherwise be scarce or unavailable. If a special skill required for the production of a given product is in short supply, whilst ordinary labour is abundant, then this skill becomes the limiting factor in the total productive potential of the operation. Thus the use of an automated device or process, which can supply the needed skill in a package, provides a very effective means of using or reducing the total cost per unit of the product, since less expensive labour can be allocated to a majority of job assignments which require lesser skills. The automated device can provide these skills which enable the machine industry to initiate and continue its operation while the infrastructure of qualified manpower is being built up. The numerically controlled machine tool is an example of such a device. The important factor is that the programme of instruction for the machine once written need never be written again. Since the control of the machine lies in the control tape and the machine itself it is possible to make identical products reliably and accurately.

The library of these tapes or cards can be progressively expanded as time goes on so that a large range of possibilities is available to the machine operator. The instruction tapes providing the intelligence for operating the machine can be prepared anywhere in the world and despatched in compact form for passing into the machine control system. Usually the majority of job skills is unaffected by the introduction of automated equipment. The operator of the specialised function must only be trained to one comparatively restricted skill. The operator training time required for automated equipment is measured in months not years. One other advantage of modern techniques such as numerical control and the use of electronic computers to prepare instruction tapes is that they give an incentive to the university trained engineer to apply some of the more sophisticated skills that he has learned.

INDUSTRIAL PROGRESS IN CERTAIN COUNTRIES

IN Turkey, where industrial development has been proceeding rapidly during the past ten years, it will be seen from the table given below, showing the value added increment rates in the main sector of the economy, that the annual growth rate for industry is almost treble the growth rate for agriculture and is notably above the rate of the other sectors.

THE VALUE-ADDED INCREMENT RATES IN THE MAIN SECTORS

	Million TL At 1965 Market Prices				
	1962	1967	1972	1962-1967 Annual Growth Rate (%)	1967-1972 Annual Growth Rate (%)
Agriculture	22.5	25.9	31.8	3.0	4.2
Industry	14.1	21.6	36.6	8.9	11.1
Construction	3.1	4.5	6.5	7.8	7.6
Communication	4.4	6.3	8.9	7.4	7.2
Housing	2.6	3.8	5.1	7.9	6.1
Others	15.5	22.4	29.8	7.6	5.0
Gross Domestic Income	62.2	84.5	118.7	6.3	7.1
Income from Abroad	-0.3	0.6	0.7	24.6	3.5
Gross National Product	61.9	85.1	119.4	6.6	7.0

If reference is made to the Country Report table, Appendix A1, Table 148, it will be seen that during the period 1962 to 1967 the main agricultural sector increases were of the order of 7% to 30%. When we look at the key factors controlling the rate of industrial progress we see that electric power production increased 75% and sulphuric acid production more than doubled at 119%. If we then turn to the employment figures given

below it will be noted that while agricultural employment barely changed during the period 1963 to 1967 with a growth of a mere 2.2%, industry employment increased 35%, construction by an enormous 47.9% and the other sectors also show substantial growth.

SECTORAL DISTRIBUTION OF THE EMPLOYED POPULATION
1963 - 1967 (in thousands)

Sector	1963	1967	Percentage Growth in period
Agriculture	9,853	9,940	2.2
Industry	1,125	1,423	35.8
Construction	338	472	47.9
Trade	435	498	19.3
Transportation	269	339	34.3
Services	809	1,066	40.4
Total	12,829	13,738	9.1

From the earlier table it will have been noted that the gross national product over this period was increasing at a rate of 6.6% per annum so that the real standard of living improved considerably during the period.

The figures for Iran, which are given in the Country Appendix Report A3, also shows a very rapid increase in the numbers employed in industry. In basic metal industries the total workers increased from 1,126 in 1962 to 4,844 in 1967 - a growth in excess of four times. In the metal products industries the workers increased from 17,830 in the former year to 35,337 in the latter year. In the machinery and electrical appliance industry sector, workers increased from 1,707 to 11,923 in the two respective years, a spectacular increase of seven times in the period concerned. In the machinery (non-electrical) and transport equipment industries, the workers increased from 17,654 in 1962 to 25,647 in 1967 and for miscellaneous industries from 2,399 to 9,407. The industrial production index rose substantially during this period for each

of these sectors and the growth continued rapidly during the next two years for which figures are available. Basic metal industries increased 23% in the two years, metal products 19%, non-electrical machinery 15% and transport equipment 141%. Appendix A6 gives the value added in the industrial group of Iran and from this table it will be seen that the index in 1969, compared with 1963, stood at:

Petroleum	217.9
Manufacturing	202.0
Mining	236.0
Electricity	303.2
Total index of industrial production	215.0

ANALYSIS OF MACHINE TOOL INDUSTRIES

Classification of the countries of the Region in accordance with the development of machine tool industries

For the purpose of this report the developing countries can be classified in three distinct groups according to the degree of development of their machine tool industries.

These categories are:

(a) Countries with no machine tool manufacture;

(b) Countries considering setting up machine tool manufacture or with limited production;

(c) Countries with well-established machine tool industries.

Most of the countries coming within the first category have a comparatively small population and their economy is principally agricultural with little general industrial development. The needs of these countries for industrial equipment can be most economically met by selective procurement in world markets. There can be no economic justification for them setting up an industry capable of manufacturing

their capital goods requirements. In the early stages of their industrial development, their engineering industry is normally solely concerned with servicing and repairing the equipment used by their food processing, transport and communications industries. As the manufacturing industry expands the demand for certain products will increase to the level at which complete or partial manufacture would be justified and the need for a wider range of machine tools than was formerly required by the purely servicing industry will be generated. Only when the manufacturing industry has become quite sizeable would there be any justification in the country contemplating manufacture of machine tools themselves.

In the second category we have those countries which are contemplating setting up their own machine tool manufacturing plants. There can be no hard and fast rules to be laid down at which stage it is economic to undertake machine tool manufacture as this will vary widely depending on the special circumstances of the country concerned. While the country has a principally agricultural economy the manufacturing industry will principally be concerned with food processing of various types. Where a textile industry develops beyond the cottage industry stage the responsibilities and complexity of the servicing industry will increase. The demands on the industry servicing the transport equipment will be much greater where shortage of foreign currency restricts the importation of new vehicles and supplies of spare parts. In some countries where severe restrictions are imposed, the scale of the transport service industry is enormous and undertakes the manufacture of spare parts and the complete re-building of vehicles which elsewhere would have been regarded as totally uneconomic. The level of wages in such countries is usually extremely low and it is only for this reason that it is possible to tolerate the vast human effort that is needed in this resuscitation of of vehicles which are almost derelict.

As industrial progress continues manufacture of water pumps, refrigerators, air conditioners, electric motors and agricultural machinery are likely to be progressively adopted. Only when these have reached a high level of intensity would there be any justification for manufacturing a limited range of machine tools. At this stage it is most important to realise that the types, sizes and variety of machine tools required in modern industry are vast and the demand for any one type may be extremely limited. Furthermore it would not be in the national interest to unreasonably restrict the importation of machine tools from abroad as the efficiency of the whole manufacturing industry would be reduced if they are not permitted to obtain machine tools which fully meet their specific requirements.

The decision to set up machine tool manufacture can only be taken after a most rigorous examination of the statistics covering machine tool imports and usage. Except in countries where extremely detailed import statistics are maintained a totally erroneous deduction may be made from a study of the statistics unless the study is conducted by people experienced with machine tool requirements. As an example, the statistics may show that one hundred lathes were imported during a given year, but a detailed examination of this figure could well have shown that no more than four or five machines of one type have been imported in this total figure for lathes, which may have covered simple engine lathes for turning small instrument shafts to large machines for turning parts such as railway axles. It may also cover capstan and turret lathes in three or four different sizes, automatic copying lathes, automatic lathes for chuck work and automatic lathes for bar work as well as others for more specialised subjects. When it can be seen, as a result of a careful survey, that there is adequate demand for certain models or types of

machine tools to make a viable manufacturing operation, a crucial decision must be made as to the types and models which should be initially manufactured.

Considerable time, expenditure and saving of national resources can usually be achieved by buying the designs from a well-established company producing machines of the type and model concerned. The choice of the right model for the particular local conditions is of paramount importance to the success of the project and the team entrusted with the responsibility for deciding on the model must have wide experience of machine tool requirements or errors may be made which will do irrepairable damage. Countries which are on the threshold of entering into machine tool production must not overlook the continuing need to gain effective utilisation and operation of their existing machine tools installed throughout their manufacturing industry. These are an important national asset and the proper utilisation and maintainance of these machines will conserve valuable foreign exchange. Properly planned maintainance schemes will do much to reduce unnecessary breakdowns which may result in the machine being out of commission for long periods whilst spare parts are manufactured or obtained from the original equipment suppliers abroad. The training of operators to adequate standards of proficiency will also assist in achieving a satisfactory level of output from the machine, both as regards quality and quantity and reduce the propensity towards breakdown of the machine which would result from careless handling or misuse.

Machine Re-building

Eventually any machine, however well maintained, will develop inaccuracies due to wear in vital parts. The time before a machine reaches this condition will vary considerably as a result of the intensity of the

of the use and the type of operation performed. In most industrial ed countries a machine at this stage of its life cycle is taken out of production and is completely re-built, either within a specialist department of the company or by an outside company specialising in this class of work. Where re-building facilities have not already been established in the developing countries full consideration should be given to establishing such facilities, either as a separate unit or as part of a machine tool manufacturing complex.

The third category covers countries where a machine tool industry has already been established. In these countries the general level of manufacturing industry will have reached the stage where machine tools of many different types will be imported in comparatively large volume. Manufacture of machine tools is likely to have started initially with simple machines such as bench and pillar drills, engine lathes in one or two of the popular sizes and in shaping machines. As experience has been gained from the manufacture of these types of machines and as competence increases, manufacture is likely to widen into more complex machines such as milling machines, hand presses and a variety of sheet and plate forming machines and then into grinding machines and other specialised types of machines for particular requirements.

Material Supply

Developing countries, which have already established their machine tool industry, will have found it necessary to ensure that a supply of high grade grey iron castings are either manufactured locally to meet the specific requirements of their machine tool industry, or can be obtained from neighbouring countries where the necessary facilities are available and through the proximity, a close interchange of technical requirements can be maintained. Due to the complexity of machine tool castings, it has never been found practical to have castings suppliers

at long distances from the manufacturing plant. There will also be a need for non-ferrous castings, but these can usually be met from local facilities. It is unlikely that the anti-friction bearing requirements can be met locally as even where a small bearing industry has already been established, manufacture only of commercial quality bearings is likely to be undertaken, whereas the machine industry requires bearings of much higher precision and quality.

Electric motors may not be available locally but particular characteristics of the motor will only be required where highly specialised types of machines are manufactured so that even though there may be no indigenous manufacture of electric motors, supply should cause no difficulty. Components for the assembly of the electrical control panels for the machines will probably have to be imported, but the panels themselves should be made up locally so that changes to meet the particular customer requirements can be easily incorporated without costly delays.

Design

In the early stages the industry will almost certainly rely almost exclusively on designs from established machine tool manufacturers who could be expected to supply under a "know-how" agreement, full details of the manufacturing process or every component concerned, together with designs and specifications for all the jigs and fixtures which may be required, together with detailed specifications for quality control and for the inspection and testing of the final product. While such an arrangement is desirable when first commencing manufacture of machine tools, this would have a seriously inhibiting effect on the technologists of the country if such a policy were to be permanently pursued. It is therefore necessary at a very early stage to establish a design department which will be capable of making the necessary modifications to the machines to meet special customer requirements and to ensure that the design of the

machine is updated in the light of improving technology. Eventually it would be desirable that future design should be developed within the country and if such an undertaking is to be successfully pursued it will be necessary for an applied research and development facility to be established. There can be no hard and fast rule as to whether the facility should be located at the factory building the machine tools or on a central basis run either by industry or by the government. It is however essential that the closest liaison be maintained between the applied research and development unit and the manufacturing establishments.

Before even the preliminary stages of design can be undertaken for a new machine an intensive market research programme should be completed. The importance of market research cannot be over-emphasised as an incorrect decision at this stage could result in mis-directing the expenditure, both at the applied research and development unit as well as during the much more costly operation of putting a new model of machine into production involving a total cycle time of some three to five years.

Marketing

Before a new product is actually in production an intensive marketing campaign will be required if sufficient demand is to be generated to prevent an imbalance between production and orders once the outstanding initial market requirements have been met. It must be emphasised that marketing is neither market research, which should have been undertaken at a much earlier period of the cycle, nor is it selling, although the latter is one important element in the total marketing operation.

As no country can hope to be self-sufficient in all their machine tool requirements, there will be considerable benefit if agreements can be reached with other machine tool manufacturing countries of the manufacture

of a compatible range of machines which do not compete. Thus the total market for the machines being manufactured by each country will be greatly increased.

Numerical Control

In the industrialised countries the machine tool industry can be one of the greatest users of numerically controlled machines in their own manufacturing programmes. This same pattern should emerge in the developing countries as the very reasons why the machine tool manufacturers in the industrialised countries have found this desirable exists even more strongly in the developing countries where manufacturing volume will be relatively small. The problems of training the programmers and specialist service engineers must not become an insuperable barrier to the installation and use of these machines which themselves can resolve so many other problems.

Machine Tool Demand

If we look at the figures for current and expected future demand for machine tools given in the Country Study Reports, we see that Iraq acquired 420 machines in 1970 and estimate that this annual demand will have risen to 660 by 1980. In the case of Syria, the figures for 1970 are 1,950 and this is expected to more than double by 1980 with a figure of 4,130.

While we have a figure for Iran in 1970 of 2,232 machines, we unfortunately have not been given an estimated figure for 1980. Although the pattern of demand for the period 1965 to 1969 was remarkably constant, with in fact a slight reduction in demand in 1969 compared with the previous years, it would be reasonable to assume, in view of the number of important engineering companies which are currently being established

in that country, that the demand will have increased by 1980 to at least fifty per cent more than the 1970 figure. It would therefore appear that demand will be in the region of 3,000 to 3,500 machines per annum.

The figure for grinding machines in relation to other types of machine tools seems to be rather high, especially in the case of the Syrian Arab Republic. In all probability this is due to pedestal grinders being counted as machine tools, which is not strictly true as they do not incorporate the generating principle which is normally regarded as a fundamental feature of a machine tool. However they are important units of workshop equipment and it is useful to know that the demand for these is likely to be rising appreciably over the current decade.

The number of milling machines required by Iranian industry each year runs at a remarkably low figure, but this presumably will increase substantially once their own machine tool producing factory comes into production and the sales staff of the company educate the other industrial companies in Iran in the advantages of this type of machine compared with the simpler manufacturing techniques.

From the Country Study Reports it seems to be clear that everyone anticipates a growing demand for machine tools and based on other world statistics there can be little doubt that machine tools will be required in ever increasing quantities in every country, regardless of whether their economy is principally agricultural or industrial. These machines may be required principally for service and maintainance requirements in the less industrialised countries but are likely to be progressively more frequently required for production as the industrial development of the countries takes place. Many, if not most of the developing countries, rely primarily on an agricultural economy and in the past

this has been principally served by animal power with simple machinery of the type which has been used with minor development over many centuries. This, however, is now changing rapidly in most countries with the use of modern tractors which are usually small, compact, reliable power units of remarkable efficiency and vastly increase the productivity of the farm worker. Coupled with the advent of the tractor, we have a wide range of other agricultural machinery, which together with the improved strains of agricultural plants, has brought about a phenomenal increase in the output per square kilometre together with an equally outstanding reduction in the number of people which need to be employed on the land. The size of the farm unit is also increasing rapidly to enable efficient use to be made of the modern machinery and in some countries collective farm groups have been formed with very large areas of land allowing maximum utilisation of each piece of farm machinery to be obtained. These developments have of course brought in their wake a considerable drift away from the land towards the towns and cities where alternative employment can be found for all of these people.

Employment of Resources

A problem which occurs in many countries, but is especially noticeable when this takes place in one of the developing countries, is the under-utilisation of plant. This may be due to lack of trained operators or to failures in company management or to delays in obtaining essential spares. These causes are fairly obvious and the remedies can usually be effected with reasonable ease because the solutions are straightforward and easily recognised. There are three other causes of under-utilisation which are not so easily corrected:

1. Too many companies producing the same type of product, where expansion of demand did not continue at the anticipated rate.

2. Reduction in demand due to a changing pattern of trade.

3. Installation of a large engineering complex which is beyond the current managerial skills and existing organizational ability.

The solution to the problems facing companies involved in the first two categories are unlikely to be obvious as the difficulties may have resulted from a complicated chain of events resulting from government actions or normal market forces or a combination of both. Before a remedy can be found a detailed study of the problem should be made so that the causes can be isolated and an understanding of them developed. A detailed market research study might show that an alternative product could be easily developed which would fully utilise the existing expertise and the resources of the plant. Alternatively, additional markets might be found outside national borders. The company may also find it necessary to look to their government to give them reasonable protection against imports at unrealistic prices or by assistance in the area of tax concessions. As the operation of these plants create employment, the government has a direct interest in ensuring that they continue to be a viable operation.

In the third category where a large manufacturing complex has been established, but production has not been achieved due to the organisational difficulties inherent with a large manufacturing establishment, the most effective means of achieving an early commencement of manufacture may be to create a number of self-contained sections within the factory, each operating on a specific product range with total management responsibility for the successful operation of the section. Many of the complicated chains of command which are essential in the very large scale operation are completely eliminated in an engineering operation of some two to five

hundred people so that the senior management link to the actual manufacturing operation is much closer and the effects of decisions are therefore more readily seen, completely understood and changes of policy to meet changing circumstances can be rapidly implemented.

In certain of the older industrialised countries some of the large manufacturing plants have been split up into industrial parks housing a number of separate self-contained factories with independent managements producing widely varying ranges of products. The possibility of following such a pattern in any of the developing countries whose large industrial units have been set up and have not commenced production within a reasonable period of time should certainly be considered.

The Increase of Employment

During the past decade or two, many developing countries have suffered greatly increased populations which frequently negative the plans for improving the standard of living for the population as a whole. However, most governments are now taking active steps to curtail the rate of increase, and with the large numbers of young people available, there is every prospect of a rapid improvement in the living standards of the people if these young men and women can be usefully employed in producing goods for internal consumption and also for export so that adequate foreign currency can be earned to meet the import bill for essential goods which will be needed for the larger population. As has already been explained, the demand for people on the land will be decreasing, even though the supply of food and other essentials grown in the country can increase substantially. The only acceptable alternative policy to agricultural employment is to expand industry so that these people can be absorbed into useful employment. The alternative

of encouraging them to emigrate from their land of birth is not likely to appeal to any government.

In the first place the industries providing the necessities of life must be expanded to meet the growing demand generated by a larger population, together with an improving standard of living. Increasing employment should be created in the food processing industry and in the industry producing the machinery for food processing. The cloth and clothing industries are also likely to find it necessary to expand together with the leather goods industry for shoes and other wearing apparel. The plastics industry is also playing an increasing part in clothing and clothing accessories, especially as many of the modern plastics are gradually surplanting the older established natural materials.

Increased numbers of housing units as well as a steadily improving standard of housing will be required so that the building material industry, as well as the construction industry itself, will have to expand considerably to meet the demand in this sector. The quantity, range and quality of furniture that will be required will also continue to rise appreciably, together with all the other items of household furnishings, kitchen equipment and so forth.

There is a second major sector which will also increase in line with, but several years behind, the basic necessities. This is the section of industry which provides the luxury and other goods which are only required by a population whose income already exceeds that which is necessary for the purchasing of the necessities of life. One of the major elements of this demand comes from consumer durables such as washing machines, radios, television, bicycles, motor cycles and automobiles. Eventually, but only when a relatively high standard of living has been reached, such as has now been achieved in the most highly

developed industrialised nations is the "Do-it-yourself" industry important. In a country like America, this has now developed into a vast industry with an enormous range of products appealing to almost every sector of the population - men, women and children of all ages.

The jet aircraft has changed the tourist industry during the past few years out of all recognition from the earlier pattern, where only rich people could afford to travel beyond the boundaries of their own country. Today, millions of people in Europe travel great distances for both summer and winter vacations. The Mediterranean being particularly popular with the northern European countries during the winter season. The cost of labour in Spain, being lower than in many other European countries, enabled them to develop large tourist resorts in their popular costal regions. The cost of the air fare on a package tour (currently £10.00 London-Majorca return) is offset by the lower hotel charges applicable in Spain compared with those of Germany, Scandinavia and England.

The tourist visiting a foreign country in addition to creating employment through the building of hotels and staffing them also wants souvenirs from the country visited. This can create a substantial additional demand for the traditional products of the country, thereby stimulating the older established industries and frequently creating new ones.

What are the cornerstones which will enable the whole economy of a country to develop in this manner? Improved education is a basic necessity at all levels whether it be to help the tractor driver to a better understanding of how to look after his machine, to help the factory worker to become a better craftsman or to enable young men to become competent technicians to meet the ever increasing demand for

their services in a world which is becoming technically more complex with every day that passes.

Technical Training

To meet the growing demand for more highly trained people, both in the theoretical and practical sphere, at every level of industry many training schools are being set up in the developing countries. The future industrial progress of the country depends greatly on these centres and it is therefore of supreme importance that they should be of the highest order. The industrialised countries could render great assistance by providing training programmes, plans for buildings to house the schools and by providing staff to commence the training until local instructors become fully proficient under the guidance of the temporary staff.

In certain developing countries young workers, after receiving their basic practical training, often take up employment in one of the industrialised countries which is sometimes looked on with disfavour. In practice, the results seem to be highly favourable to the developing country as the young man usually returns to his own country after a period of three to five years, having greatly improved his skill. During the period he lived abroad, he has in all probability regularly sent an appreciable part of his wages back home, either for use by his family or for investment to be used by him when he returns home. His improved skill when he does return home will be of considerable benefit to his employer, as not only will he be capable of undertaking better work himself but through example he will improve the quality of work produced by those working with him.

Economic Plant Size

The industrial development of a country proceeds most quickly where a number of medium sized companies are established rather than a few very large industrial complexes. The problems of commencing manufacture on a smaller scale are much less and practical difficulties can be much more easily and swiftly resolved and the market for particular products effectively tested before undue commitment to a particular product is established. Once success has been achieved, both in production and marketing, rapid expansion can take place. It is a matter for government policy whether technical agreements or joint venture operations with established and successful companies in other countries should be undertaken. Such agreements can greatly shorten the time taken to get a new establishment into production, thereby offsetting the payments to the outside company against the interest which will be paid on the capital investment for a much longer period without such assistance. Co-operation between neighbouring developing countries may present many political difficulties but this could offer tangible benefits in the form of increased labour demand, improved efficiency and greater financial return on any development schemes concerned. Efficient production requires adequate throughput, this is fundamentally true whether it is producing machine tools, automobiles, washing machines or radios.

Specialisation and Training

During the early days of the Industrial Revolution in western Europe, each company offered a very wide range of products without becoming a specialist in any particular one and in the machine tool field companies produced machines of almost every type depending on the demand from their customers. Today, specialisation has developed to the extent where not only a company may restrict its production to building lathes, but will further restrict it to building only certain

types of lathe. To do this effectively an adequate market must be obtained. In any single developing country, a market is likely to be inadequate for really efficient production of each type of machine. Co-operation with neighbouring countries could therefore offer very real advantages. Technical assistance could cover joint use of certain common facilities for matters such as research and testing and possibly certain machining operations carried out on large complex machines, where each country could only employ such equipment for a limited number of hours per week, would greatly improve efficiency. Co-operation in the manufacture of specialised parts could also well be a field for fruitful exploration. The industrialised countries could render great assistance to the developing nations by entering into technical agreements to provide manufacturing and marketing "know-how". Companies specialising in particular product ranges, for which there is a demand in the developing country could establish plants in those countries on a joint venture basis. Such an arrangement has the advantage that the parent company will send management with a proved record of success to run the company in order to see a return on their investment as rapidly as possible. Thus also meeting the needs of the developing country by insuring that their national resources are fruitfully employed at the earliest possible date. The developing countries have a great need for experienced management and technologists. The loan of such people from the industrialised countries is often one of the most effective ways of training the local staff in these skills which they may have learnt theoretically but only through practical application can they become proficient. The industrialised countries can further help by inviting personnel to their country to attend training courses at universities and other institutions, for practical training in their factories and also to witness exhibitions of a technical nature such as the highly specialised machine tool exhibitions held in Europe every two years.

The extent of the industrialization of a country is indicated by its consumption of engineering products and the undermentioned table for imports into the countries of the region is therefore especially interesting.

IMPORT OF ENGINEERING PRODUCTS BY
DEVELOPING COUNTRIES OF SOUTHERN EUROPE AND THE MIDDLE EAST
FOR THE YEAR 1969

Millions US Dollars f.o.b.

Countries	Total Engineering Products	Electrical Machinery	Transport Equipment	Metal Working Equipment	Machine Tools	Power Machinery	Agricult. Machinery	Chemical Industry Equ.
Cyprus	59.0	10.7	30.8	0.3	0.2	1.6	3.1	17.0
Greece	772.2	100.7	429.8	7.8	6.2	35.1	31.6	241.4
Spain	1044.3	190.0	181.2	55.2	31.9	74.5	62.3	672.0
Turkey	400.8	75.0	100.5	17.5	10.4	34.4	19.0	200.9
Bahrein	27.2	9.1	8.3	0.1	0.1	2.2	0.2	9.8
Iraq	191.8	24.6	50.7	2.0	1.8	7.2	8.6	114.9
Israel	414.9	111.9	122.7	19.2	12.5	27.2	13.5	180.2
Jordan	46.4	16.4	13.8	0.3	0.2	3.2	1.6	16.2
Kuwait	295.3	49.8	134.5	0.6	0.4	15.0	0.1	74.0
Lebanon	153.9	37.6	64.2	1.1	1.0	9.6	3.4	52.2
Saudi Arabia	284.9	61.2	142.6	2.1	1.9	14.3	5.3	78.0
Syria	126.0	21.2	39.6	0.7	0.4	4.4	4.8	41.6
Others*	140.1	27.4	57.0	0.5	0.4	14.1	3.0	52.0
Total World Import	76,378	14,135	28,642	2,668	2,135	4,212	2,699	32,077

* Aden, Muscat and Oman, Qatar, Trucial Oman and Yemen

From this table it will be noted that the imports of machine tools into most of the countries of the region with the exception of Spain, Turkey and Israel are quite limited. The total volume of engineering products however, is not insignificant and it must be hoped that as the engineering industries of individual countries expand, that intertrading will steadily increase, either on a bilateral or multilateral basis both in respect of general engineering products and especially in machine tools.

SELECTION AND UTILIZATION OF MACHINE TOOLS

The selection of machine tools may appear at first sight to present great difficulties for the developing countries owing the diversity of types and performance characteristics. In fact, the machine tools made in all the industrially developed countries to perform a given task tend to be of broadly similar design in greater respects and this facilitates comparisons.

Data for the Selection of Machine Tools:

Metal-cutting tools vary widely in accordance with:

(a) The types of cutting tool: drill, reamer, tap, cutter, milling cutter, shaving cutter, grinding and polishing wheels.

(b) The machining method: turning, milling, drilling, gear-tooth cutting, grinding, polishing.

(c) The grade of surface finish, from roughed to finished surfaces.

(d) Workpiece dimensions, from bench-type machines to those capable of machining parts dozens of metres across, weighing hundreds of tons.

(e) Grade of accuracy, from machine tools for roughing work to those for precise work.

(f) Range of work: universal, general purpose, specialised or special purpose machines.

(g) Number of tools used simultaneously: single or multiple-spindle, multiple-carriage, multiple-tool machines.

(h) Number of parts machined simultaneously: single or multiple position machines.

(i) Degree of mechanization and automation, from those that are continuously serviced by an operator to fully automatic machines.

(j) Certain design features: vertical, horisontal, drum type, open side and duplex type, pendulum type, unit-type machines.

(k) other features of operation: stationary or portable machines.

General-purpose machine tools suitable for various operations are widely used in jobbing work, small-scale and batch production. Machine tools of this kind are comparatively cheap, have a wide range of speeds and feeds, are simple to set-up and maintain but their production facilities can be properly used only by highly-skilled workers. The operator must be able to, without the aid of fixtures, mount, align and fix the parts to be machined, set up the cutting tools, perform some operations manually and make all necessary measurements. The volume and quality of output depends, to a great extent, on the operators skill.

Centre lathes, knee-type milling machines, shapers, vertical drilling and conventional cylindical grinding machines are examples of general-purpose machine tools.

Specialized machine tools are designed for machining workpieces of one type but different sizes. They allow quick and precise mounting of workpieces and simultaneous machining by several cutting tools; they give a high rate of output but are economical only when large batches of workpieces have to be manufactured.

A machine tool of the correct size can be chosen on the basis of the criteria listed below.

Dimensional criteria for selection of a machine tool.

Machine tool	Dimensional criteria
Turning and engine lathes,	Swing over the lathe bed; distance between centres.
Vertical and radial drilling machines	Maximum drilling diameter for medium-carbon steel.
Horizontal boring machines	Boring spindle diameter and table size.
Cylindrical grinding machines	Maximum diameter and length of workpiece machined
Internal grinders	Maximum diameter of hole ground

Machine tool	Dimensional criteria
Surface grinders	Rectangular table width and length or rotary table diameter.
Gear hobbing, gear shaping, gear shaving, gear grinding, and gear-tooth chamfering machines.	Maximum diameter and module of workpiece.
Knee-type horizontal and vertical milling machines, copying milling machines.	Width and length of table working surface.
Single-and double-upright planers.	Maximum workpiece width and table working surface length.
Shaping machines, slotting machines.	Maximum ram stroke and shaping width.
Thread-cutting machines	Size range of threads to be cut.

The types and sizes of machine tools in a manufacturers range, usually follow an arithmetical or geometrical progression in regards to the main technical parameters. A closely spaced progression is used for the common types and sizes of machine tools in order to provide a machine which will precisely meet the exact requirements of individual users.

The Influence of Machine Tool Design on Retention of Accuracy and Life.

The life of a machine tool and the maintenance of its original accuracy, depends to a great extent on its design. Short term tests throw no light on these important matters, they have to be evaluated indirectly by considering the parts of the machine whose performance is critical to accuracy and durability. The guideways and spindle bearings are decisive for maintaining the accuracy of most machines. Spindle bearings are generally of the anti-friction type (ball or roller) and these must be properly lubricated with the right lubricants if satisfactory life is to be obtained and prevent premature failure of the bearings. Correct adjustment of the spindle bearings is important as over tightening of them will lead to overheating while excessive clearance will cause machine chatter under working conditions.

The bearings must be of a suitable type and of adequate proportion to meet the radial and axial loadings which will be imposed on them. They must also be of adequate precision not only to meet the accuracy requirements but also to ensure a long period of working life under arduous conditions. The great variety of operating conditions makes it difficult to specify general requirements and guideways. Most guideways are made of cast-iron and these are sometimes hardened by suitable means. In recent years some manufacturers have provided plastic or non-ferrous surfaces on the mating parts to reduce friction and increase life. The guideways should be of adequate proportions and should have some form of protection to limit the ingress of dust and particles of dirt.

Acceptance Testing.

When a new machine is received, before it is put into service a simple but thorough programme of testing to ensure that the machine complies with the manufacturers specification and is performing satisfactorily, should be undertaken. The machine should be set-up on an adequate foundation either in a test room or on its permanent foundation in the machine shop. Before the acceptance tests are started, the machine tool, properly mounted on its foundation, must be completely equipped with all the accessories and tooling. The lubrication and hydraulic systems of the machine should be filled with the appropriate grade of oil. The machine should then be run for an appropriate period to allow it to reach its normal working temperature. The machine should then be checked, to ensure that all the operating characteristics correspond with the makers certificate. These include the correct length of movements of all units of the machine, sizes of workpieces accepted, spindle speeds, feed rates, etc., as well as performance to within the specified accuracy. Further tests should be carried out to see if the machine is free from vibration, that reciprocating units reverse smoothly, that the noise levels are acceptable and all the controls function satisfactorily. When these tests have been completed, tests should be undertaken to ensure that

the machine operates satisfactorily under full power and that maximum cutting forces can be obtained. The question may be asked as to how well acceptance tests for machine tools are adapted to conditions which prevail in developing countries. There are many opportunities for machine tool manufacturers in developed countries to be told about any lack of suitability to conditions in the developing countries. Moreover, the more advanced developing countries have standard bodies which are members of the I.S.O. and can make their views known when international recommendations are being drawn up. To ensure that machines meet the special conditions in the developing countries, U.N.I.D.O. might assist these countries to work out suitable adaptations which could then be submitted through the I.S.O. for international action.

Utilization.

Assuming that a suitable machine has been selected and properly installed and passed the acceptance tests, it will be of little value unless skilled operators are available. It is therefore of paramount importance to ensure that there is an adequate supply of suitably skilled operators to run the types of machines which are to be installed in the factory. The machines are a valuable national asset and should be operated intensively, i.e. double-shift working, if their full potential is to be realised. It is also necessary that the operators should be sufficiently trained to obtain the maximum performance from the machine and to prevent unnecessary breakdown due to mishandling. A suitable production control system will be needed to ensure a steady flow of suitable work to the machine and the planning department will have recommended the material to be used, the way in which it is to be machined and the type of tooling which will be necessary to permit efficient manufacture. Even in the hands of a fully qualified operator, the machine will eventually break down unless a programme of maintenance is carried out regularly. It is preferable that this should be

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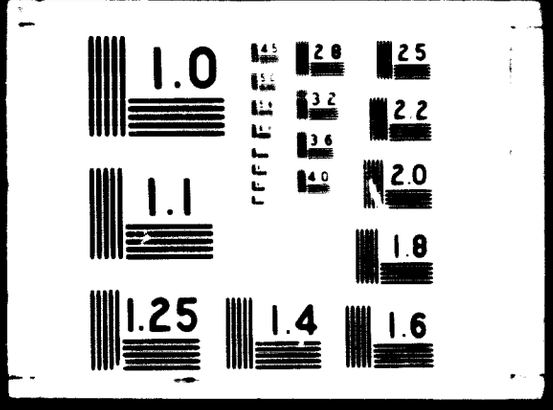

undertaken in accordance with a carefully planned programme of preventative maintenance which extends beyond the elementary necessity of proper lubrication.

After some years service, certain parts in the machine will need replacement and these should be available before they are actually required as otherwise the machine will be out of action until the part can be manufactured or obtained from the original machine supplier. Replacement of essential components will keep the machine operating but eventually, the original accuracies will have been lost and the time will come when the machine must either be replaced or re-built. The rebuilding offers the advantage that the cost is much lower, only a small percentage of new materials are used and the machine will be a least as good as it was originally and may retain accuracy thereafter for a longer period as the major components of the machine will be more stable than when the machine was new. Each of these aspects is extremely important to obtain satisfactory utilization from the metal working machines.

ECONOMY OF THE MACHINE TOOL INDUSTRY

Trade cycles and the machine tool industry

In relation to the economy as a whole, the M.T. is an article which is more sensitive than most others to market conditions. This applies both in times of economic crisis as well as in periods of revival. The M.T. is affected in this way because it holds a key position in industry while at the same time providing an accurate indication of market trends. The first aspect, already dealt with at length, derives from what we may briefly describe as the catalyst effect it exerts on the metalworking and electricity industries, its main users; these in turn being the main pillars of the manufacturing industry and of the economy as a whole.

The second aspect is typical of the industry because one of the features of M.T. production is that of forecasting economic trends since the user will delay or put forward ordering a tool according to whether the economic outlook appears favourable or not.

The periodical fluctuations to which the demand in market economies is subject, have such a sharp effect on M.T. production that absorption inside the country seems as if it were thrust forward or backward by a multiplier. In other words, the trends taken by orders

become a pre-amplifying indicator. (1)

For example, the Italian economic crisis of 1963-1965 caused a 43% drop in value in the home demand for two years running: thus in 24 months sales of M.Ts in a large industrial country fell to less than one third of the level at the outset. Conversely, during the period of expansion in 1966-1970, average annual output rose by over 7% (only a part of which, however, went to the home market; exports in fact reached about 55% of the total, almost the safety high-water mark).

The consequences of the great sensitivity which this branch of industry shows towards economic trends and periodic fluctuations, typical of a free economy, are:

a) Negative

(i) they hinder expansion of output and, from some points of view, specialization as well. When busi-

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(1) The National Bureau of Economic Research in the USA has chosen the new orders for M.Ts to be one of its 26 basic statistical indicators. These form a group providing advance indications consisting of 12 pilot indices possessing a forecasting capacity of up to as much as eight months.

In times of economic depression, the time series concerning cancellations of orders reaches 20% of the total, but tends to fall to about 2% in times of expansion. Both ways the forecasting capacity can be as much as 14 months.

However in order to be able to use the new orders and/or cancellations as really valid indicators, data must be available on a very long series reflecting the demand over a period of years, and it would seem that only the United States statistical bureaux have this data at their disposal.

ness is good, the manufacturer prefers to contract out extra work rather than invest in more machinery which might turn out to be anti-economic within a short time. As a precautionary measure too, he tends in any case to diversify his range of articles to some extent;

(ii) they hinder concentration, automation of productive processes, and personnel training.

b) Positive

On the other hand, to counterbalance the negative effects of unfavourable trade cycles, manufacturers try to reach out beyond the home market and export their goods abroad. The machine tool is an article universally accepted on all markets, and the M.T. industry may be described as a super-national service. Statistics in fact show that one out of four is exported, and that the main exporter countries are, at the same time, those which import most of them.

National and international production planning

The very fact that the M.T. is an "international" product emphasises the need to plan its production at different levels. This may be divided into three stages:

a) planning by each establishment: in planning their production, establishments at present prefer to build all of one type until the planned quantity is reached, then start on another one, rather than keep several going at once. In this way warehouse stock is avoided as much as possible and they can also maintain a rational proportion between standard lines, based on frequent market analyses, and

machines made to order.

The medium and large sized establishments tend more and more to get market surveys made by specialized bureaux. Generally speaking, however, trade cycles make manufacturers unwilling to adopt medium and long-term production and selling plans. Only in the United States are advanced methods of production (e.g. automation) and management (forecasting) being used to an ever growing extent.

b) production planning at a national level: in this field there is no gap between the M.T. industry in America and that in Europe. The U.S.A., however, maintains considerable superiority in production technologies and in managerial techniques, as well as devoting a bigger overall sum to research. Further, the U.S. engineering and electrical industries use many more transfer and numerically controlled machines than are used in the same industries in Europe, and it cannot be left to private enterprise alone to overcome this disadvantage. It is up to Governments to devise policies of economic and financial concentration, of rationalization of production, (see the successful U.S. scheme of taxation relief on investments) of specialization and, finally, organization of research.

c) international planning and co-ordination: as stated under (b) above, each producer country, especially in Europe, should devise its own machine tool development plan, but it is clear that there must be co-ordination (inside the EEC, within the twelve member countries of the European Committee, between the latter on the one hand and the U.S.A. and Japan on the other; finally between the market economy countries and the Socialist countries). Such co-ordination

should harmonize with the initial schemes of the countries now organizing their industrial take-off. Only in this way can the output of a product of such an intrinsically international character be raised to such a level where it takes the form of a service for the world community.

Price and quality in the production of machine tools

Reference has already been made to another aspect of this industry: the ratio between price and quality. Though at a high level in the more advanced establishments, specialization in production involves neither a process of standardization comparable to that in progress in other fields of industry, nor a tendency towards concentration to obtain internal or external scale economies. Further, at least where special executions made to order are concerned, every kind of M.T. producing establishment must operate a policy of productive diversification. These conditions already make it hard for firms to carry out a policy of containing costs while maintaining quality. For that matter, the industries ordering the greatest quantities of new machine tools go for quality rather than a low price. In the case of these users - the engineering and electrical industries - investments in M.Ts (which as we have seen do not exceed 30% of their fixed capital) are not generally decisive in making their final products competitive or not.

Where the price of an M.T. assumes considerable importance (generally in the case of the small user or artisan type of workshop), a second-hand machine can be bought especially if it is many-purpose which practically never

become obsolete. There is an enormous market in second-hand machines (rebuilt or overhauled), and its sales are not much below those for new machines.

Why the machine tool industry is vital to a developing economy

Being so flexible as regards technology and type, the production of machine tools is one of the most interesting for any country but especially for those now developing their industries; this is so because:

a) it occupies a central place in interrelations between the difference branches of production, and is of paramount importance for the development of the engineering and electrical industries;

b) its range of types is very wide indeed, to such an extent that no country can monopolise it, or a big part of it;

c) even so, it lends itself to great specialisation and any country, according to what it has available, can play a special role in world production;

d) in the initial stages, and even in more advanced ones, the M.T. industry does not, as a whole, require very big investments;

e) M.T. production means active participation in world markets because import and export business forms an essential, technical and financial part of its evolution;

f) at least within certain limits, this industry does not

obey the laws of industrial concentration and does not need vertical integration with industries with a high rate of capital (iron and steel, primary metals, etc.);

g) it enables producers to work in a market where quality counts more than price. The smaller users can benefit from the existence of a second-hand market, as the many-purpose machines do not get out of date quickly, and in view of the length of amortization characteristic of machine tools, including the automized models.

We feel that the positive features listed above, apply to any country making M.Ts whatever its political structure may be: whether a market economy or a socialist economy. In this second case, however, in addition to the well known problems relating to price fixing which is of particular importance in an industry which must hold its place in world trade, what is said under point (f) above does not apply (concentration etc.) since, as we have seen in the case of the U.S.S.R., in countries with a Socialist economy the M.T. industry is concentrated to a high degree.

Essential preliminary conditions and obstacles to overcome

At this point it would seem advisable to sum up the main <u>difficulties</u> which a development of the industry is facing. These difficulties are even more serious when it has to be started from nothing as in the case of countries where the development of an industrial economy is in the early stages, and may be described thus:

a) In a market economy the birth of a machine tool industry

is strictly subordinate to a previous development of a metalworking industry: indeed, in the already industrialized countries this fact has strongly affected the question of where it shall be localised. This condition is not limited to the initial period but becomes permanent because the percentage of end components used is very high; it is in fact closely linked to the metalworking industry both for its raw materials (from primary metals industries in particular), for its semi-finished products (the engineering industry in particular for bearings, gears, etc.) for an extremely wide range of finished goods (motors from the electrical industry etc.), involving the most widely diversified industries (electronics in particular). Thus the degree of interdependence between the M.T. industry and the class to which it belongs is very close seeing that 90% of the M.T industry's output is absorbed by this class from which in turn it receives 90% of its inputs (cf.Table 3).

This interdependence is not of course limited to the relationship between this branch and its class of industry at national level but is also evident in world trade. A quota of the imports of each country (of considerable size both in the advanced countries and in those in the developing countries) concerns parts or components (electric motors, electronics) as well as manufactured goods and/or special materials (special steels, bearings, etc.).

b) The difficulty of creating a category of trained and skilled labour, and of maintaining a constant level of availability.

c) the lack of independence felt by the M.T. industry in

deciding what its final products shall be, seeing that these decisions are mostly made by the users.

d) Normally speaking, technological development of a M.T. industry cannot be even (see point (c)), partly because its productive dimensions are usually smaller than those of the user establishments and this puts it in a subordinate technological position.

Some specific problems and long-term prospects

We think it may also be helpful to bring out some specific problems arising in the M.T. industry, as these are of particular interest to the economically developing countries:

a) the possibility exists of passing through an intermediate stage of assembling machines designed abroad, consisting of parts which may or may not be produced locally. This stage may precede the creation of a local M.T. industry, but must be carefully considered in relation to the condition of economic, financial and technological subordination to the country supplying the parts and the know-how, to which such a stage might lead.

b) once the local industry has been set up, as previously mentioned, its products must enter the channels of world trade as soon as possible. Each country must therefore be aware of the function it may have, either as a producer of standard machines or as a producer of special and/or complex ones. It must always be borne in mind, however, that machine tools are "mature" products, and, from a certain qualitative level upwards, they pre-suppose a fairly high

degree of technological development.

For these reasons, the efforts to set up and develop a M.T. industry, within the economic framework of a country must be most carefully considered and graded.

An essential condition for organizing exports, or sales on the home market too for that matter, is the existence of a proper supporting infrastructure (servicing, spare parts, stocks, promotional activity at home and abroad, attendance at international exhibitions, etc.) all of a very high order.

It should finally be recalled that the long-term prospects for developing a M.T. industry, so that it may take its proper place in world economy, converge in a number of fundamental directions, these being:

(i) the increasing extent to which automation is applied to machine tools, partly due to the state of unbalance between the rate of development of production and consumption and availability of skilled labour;

(ii) the tendency towards the construction of ever more complex and automated M.Ts leading to an ever closer interrelation between this industry and the electronics industry;

(iii) the tendency within the industry as a whole to increase the number of forming machines compared with that of cutting machines. The forming machines incorporate more and more advanced technologies (laser, numerical control, plasma etc.), further confirming what is said under (ii).

For a precise understanding of point (i) we would recall that while in the automobile industry for example automation has gone beyond the stage of production and is

now applied to assembly work, in the M.T. industry it has not yet been possible to apply automation to all the processing operations.

PRE-CONDITIONS FOR [illegible] MACHINE TOOL INDUSTRIES

The degree of industrialization in the developing countries varies considerably from the principally agricultural operations of some countries to comparatively highly industrialized economies. The structure of the industry in each developing country depends on the character of its natural resources, climatic and other peculiarities. In the least highly developed countries, the agriculture will rely almost entirely on man and beast, following the traditions of hundreds of years of practice, while in the more developed countries even the agricultural activities will be comparatively highly industrialized using every conceivable type of modern agricultural machinery. Once agricultural machinery and mechanized transport have been introduced, engineering facilities for the maintenance of this equipment become essential. In the first instances, the machinery would have been entirely imported from more industrialized countries and the replacement parts will be imported from the original equipment suppliers. If the equipment is to be operated efficiently, there will however be a need to set up adequate training facilities to educate the necessary maintenance staff. Concurrent with this training, will be the need to establish adequate servicing facilities in suitable parts of the country.

Countries Having No Mechanical Engineering.

It will only be satisfactory in the very early stages of development to rely on importing all the spare parts which may be required. The repair centres should expand at the earliest opportunity to include a small machine shop where the simpler types of parts can be manufactured and all parts can be remachined to extend their useful life. It will be most important to ensure that the training facilities develop in parallel with the repairing facilities. The developing country should make use of the experience of industrially developed countries by inviting specialists who have experience

and qualifications in the relevant fields to assist with their training and the establishment of repairing facilities.

Countries Having Mechanical Engineering Industries.

The development of metal working equipment production in a country cannot be isolated from the development of other branches of industry. Thus, the development of metal working equipment should be regarded in a complex with the development of the whole industry of a country. One of the primary problems to be solved when starting the development of metal working machine production in a country is to determine what types and sizes of metal working machines should be produced in the first place. Both in the initial and developing stages of development it is necessary to determine the technically and economically adviseable minimum quantity of sizes and types of machines that will meet the demands of industry. In the initial stages of development of a metal working industry, it is adviseable to produce universal machines designed to perform a wide range of operations. Machines in the greatest demand in a developing country are usually, centre lathes, drilling machines and shaping machines. These may be followed by milling machines, surface grinding machines and cylindrical grinding machines.

The development of metal working machine production should be effected in close contact with all other industries being developed in a country. It is the user industry which ultimately must determine the types and sizes and quantities of metal working machines which are to be produced.

The long term plans for the production of metal working machines must proceed on the long term plans of the development of the industry in a country as a whole. Furthermore, it is necessary to determine which of the machines should be produced locally and which of them should be imported. When it is decided to establish a metal working machine industry in a country, it is suggested that a scientific engineering centre should be set up to undertake the necessary tasks which should precede the establishment

of a machine tool industry and continue throughout the development period.

A suggested organization for the centre has been prepared as follows:-

Departments of the Scientific and Processing Centre and their Tasks.

Section 1. To study the needs of industry in metal working equipment and to determine types and sizes of necessary machines. To propose the types and sizes of machines which should be produced in the country and to recommend the number of machines of each type to be produced. To recommend the types and number of machines imported.

2. To study the design, operation and service for both imported and locally produced machines. To translate into the language of the country specifications and service manuals for imported machines for the use of the customer. To assist customers in setting-up and proper servicing of machines, whether imported or produced in the country. To carry out this work, the centre should have a demonstration hall where specimens may be placed. The demonstration hall may also be used for teaching the representatives of companies to operate these machines. The demonstration hall may also be used for the manufacture of certain parts. The kind of parts and their number should be suitable for machining in this enviroment so that it will be possible to demonstrate visually the operation of the machine and methods and techniques of machining. The fulfilment of such orders should on no account turn the demonstration hall into an ordinary production shop and prevent it from carrying out the tasks for which the hall is primarily intended.

3. This is a design section with responsibility for creating new models of machines for regular production together with the responsibility for improving the design of machines already being

produced. Before starting to design a machine, it is necessary to get thoroughly acquainted with machines of similar purpose and with their operation. To study similar machines produced in other countries and to determine specifications suitable for the conditions which the model under consideration will be used. In the initial period of the development of the national metal working machine industry when there is no experience in developing new machines, the reproduction of some foreign machines may be advisable. This may be done by means of purchasing licences covering design and complete manufacturing techniques or simply purchasing drawings from foreign government bodies or firms. The manufacture of the first prototype will usually have been undertaken by the engineering centre. In the process of manufacturing a model of a new or modernised machine according to the drawings worked out by the designs section, the designers render assistance to the production workers in the settlement of any engineering difficulties which may arise. After the prototype of the new or modernised machine has been produced, it is subjected to a detailed laboratory test and where necessary design alterations are effected. After the prototype has been tested, it is usual to produce a small batch of five or ten machines and install these at various companies for field tests. These tests may also reveal additional defects in the machine which should be corrected before the design is passed-over for quantity production. On the staff of the design section it is reasonable to have groups specialising in the following types of machines:

Turning machines.
Drilling and boring machines.
Planing, slotting and milling machines.
Grinding machines.

Gear cutting machines.

Metal forming machines.

If woodworking machines are included in the programme, these should also have a specialized design. The availability of national standards is of extreme importance for the improvement of design work in this field of technology. While working out national standards of metal working equipment and tools, it is desireable to use as much as possible the corresponding recommendations of International Standards Organization (I.S.O.). The design section should also include groups dealing with electrical, hydraulic and lubricating equipment for metal working machines. These groups should have at their disposal laboratories furnished with appropriate apparatus.

4. This section deals with the problems of iron and non-ferrous casting, steel and its heat treatment, flame cutting, electric and gas welding, plastics and rubber technology, lubrication (Tribology), paints and resins. This section should have, foundry, metallurgical and chemical laboratories which will allow all necessary investigations and tests to be carried out.

5. This section deals with the problems of metalworking techniques together with the associated technologies of cutting tools and measuring equipment. The section studies the achievements of world engineering in the field of metalworking technology and takes measures to introduce into the national industry those of them which are of interest. The section is also responsible for carrying out experimental and research work on cutting and forming metals.

6. This section deals with the proper service and repair of metal working equipment. It is responsible for the preparations of recommendations and provision of the suitable manuals on all aspects of service and repair.

7. This section is responsible for all questions of scientific and technical information. The section should have a group of translators who should make translations into the language of the country of all technical articles and manuals that may be of interest to the engineering centre or manufacturing industry. It takes measures to acquire technical papers of interest and to maintain a suitable technical library.

The suggested structure of the scientific and engineering centre outlined above, is provided only as a model and there may be substantial differences, depending on the specific conditions of each country.

Scientific and Technical Assistance of Industrially Developed Countries.

In the initial period of creating the metal working equipment industry in a developing country which lacks both experience and adequately skilled specialists, it is important to make use of the experience of industrially developed countries by inviting specialists who have experience and qualification in the designing and manufacturing metal working machines to assist in the operation. Such assistance is usually given under a "know-how" agreement or a manufacturing licence agreement. Alternatively, specialists from a developed country may be invited as consultants on questions of creating and developing the production of metal working equipment. When it is necessary to construct a new enterprise or to reconstruct an existing one, in a developing country, agreements are often made with government institutions or firms of a developed country to prepare and implement the complete project including the provision of the necessary buildings, machines and equipment, the organisation of production and the training of staff at all levels.

In carrying out this work, specialists from the developed country share their experience in developing the new enterprise with the local staff and this is a good school for training specialists and workers in a developing country.

It is also common practice for the specialists and workers to recieve training in the industrially developed country. It is also a common practice to send a number of young specialists from developing countries to study at higher educational institutions of developed countries.

In the case of establishing a scientific and engineering centre in a developing country, it is advisable to invite specialists from a developed country to render assistance in organizing its work and improving the professional skill of its staff. It is also useful to send specialists from a developing country to the scientific and engineering centres of industrially developed countries for one to three years to study designing, research work, technology and other disciplines.

ARAB REPUBLIC OF EGYPT

Status of Machine Tools.

Before 1955, machine tools were used in the different industries for the following purposes:-

Production of simple items of spare parts for machines and equipment into service.

Production of some products either needed for local consumption or for other industries.

Training purposes in polytechnical schools.

Pressings of some products.

The majority of these machine tools consist mainly of general purpose machines namely:-

Centre lathes.

Drilling machines specially bench and pillar drills.

Small percentage of milling and grinding machines.

Presses and sheet metal working machines.

The use of other types of machine tools was comparatively limited. When the U.A.R. authorities started the national plan of economic development with the aim of doubling the national income in ten years, a complete plan for industry in the different fields was considered necessary. To implement the plan, it was essential to study the status of the different existing industrial factories and companies, the existing manpower and its skill, the national resources, number, age, quality and types and precision of the machine tools in service and investment needed for executing the national plan.

It became clear that it was of vital importance to introduce a machine tool industry into the U.A.R in the first five year plan of industrialisation.

About 80% of the existing tools are used in the different industries either for production purposes or in the maintenance shops. About 10% are used in the training centres and the remaining 10% are used in small, private production shops.

Demand and Production, Import and Export.

Statistics show that the demand for machine tools is increasing rapidly especially for, general purpose heavy machine tools, grinding machines of different kinds and capacities, special purpose machine tools needed for different engineering industries, precision machine tools for manufacture

of special cutting tools, jigs and fixtures.

Although the imported machine tools do not show the volume of domestic demand, it gives the general trend. The appendix shows the imports of different machine tools which participate in the plans for industrial development.

The expected demand, in thousands of pounds will be:-

1975	5.200
1980	6.500

Domestic Production.

The production of machine tools in the U.A.R. started in 1964 and production during the past five years is shown in the appendix.

The extension of machine tool building up to 1980 will cover adding the production of new types and sizes of the existing types of machine tools, introduction of semi automatic and automatic machines.

At the present time all the quantities produced are used locally in the different industries but it is planned that a part of the future production will be exported in quantity starting from 1973. It is also planned that the volume of export of machine tools will be about five hundred thousand Egyptian pounds after 1975.

Ancillary Industries.

The following ancillary industries exist which cover all the needs of the machine tool industry:-

Foundry covers all the iron parts, steel castings and precision cast parts.
Foundry for the malleable C.I. parts.
Forging plants for the manufacture of all forgings (die or free forgings)
Non ferrous plant for the manufacture of all non-ferrous materials and castings.
Factories for the production of painting materials, plastic parts together with all consumable materials.

Moreover, there exists also other ancillary industries that cover a part of the following materials:-

Ball bearings (few items)
Fastening parts.
Standard cutting tools.
Special cutting tools, jigs and fixtures.
Electric motors and components.
Commercial sheet and bars.

80% of the needs for production are now procured locally and the remaining 20% are imported from different countries.

Governmental Policy.

In general, the policy of the U.A.R. authorities is that the machine tool industry is added to the group of industries to receive first priority and that extensions should be carried out in parallel with the concerned ancillary industries such as foundries, forging plant, etc., with the aim of supplying the machine tool industry with more than 90%. Domestic production of machine tools should achieve about 60-70% of the demand for general purpose machine tools. Priorities in the production programme should be based on domestic demand together with the production cost in comparison with world prices and taking financial measures to favour the industry, especially in the first year of production.

Development and Utilization of Machine Tools.

When setting up a machine tool industry in a developing country it is usual to co-operate with one of the developed countries in order to acquire proven designs and the manufacturing "know-how". This has the disadvantage that, due to the delays in commencing production, the design may have become obsolescent but on the simpler types of machine, design changes are comparatively insignificant. In some cases, developing countries obtain the initial design of simple machines but the production of prototypes is one of the most important problems that hinders the progress of the machine tool industry in the developing countries.

The newly established machine tool industry, depends mostly on the domestic consumption so that production programmes cover small quantities of many different types. The production of small batches, increases the difficulty of effective loading , requires the use of general purpose machines and simple technology which requires skilled labour especially in the trade of turners, grinders, tool makers and millers. As all these skills are needed in other industries, there is a shortage of labour and turnover is higher than average. Production of special tools, jigs and fixtures presents special problems as these require highly skilled workers and high accuracy machines. The shortage of spare parts, especially for some of the imported machines results in stoppages which cause disruption to production programmes. Shortages of certain materials and components, which cannot be supplied by the domestic ancillary industries, may also cause difficulties due to delays in importation. Consideration should also be given to ways and means of improving utilisation of machine tools throughout the engineering industry.

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Education and Training

The provision of trained personnel in sufficient numbers and to adequate standards plays a key roll in any industry. Where industry is expanding rapidly, the special requirements to establish training centres where these additional skilled workers, technicians and technologists can be trained to the required standards in large numbers. Due to the rapidly changing technology, there is also a need for retraining skilled workers and technicians who received their original training in earlier years.

Consideration should be given to establishing a number of training centres in the industrial centres of the country.

Introduction of Numerically Controlled Machine Tools

In the future it is expected that numerically controlled machines will be used in the U.A.R. in increasing quantities. The problems that should be studied and covered are the high initial cost of N.C. machine tools and its relation to mass production and marketing, training of the personnel for running these machines and the availability of adequate maintenance and repair facilities.

Technical Assistance

It was foreseen when elaborating the plan for industrial development that the U.A.R. should refer to a developed country to assist the U.A.R. in establishing a machine tool industry on a scientific basis and an agreement was reached with the U.S.S.R. The following points had to be considered. The economical points of view. Submitting technical and technological documents for the machine tools as per the production programme; rendering the technical assistance either by its training group of U.A.R. personnel abroad or by deputing experts whenever necessary; the delivery of machines and equipment needed for the annual production programme and that as the financial burden is a main factor in taking a decision either for starting this industry or carrying out any future extensions, so the developed countries should offer credit facilities with a reasonable annual interest rate.

It is understood that although the development in the field of producing numerically controlled machine tools is now playing a key roll in the machine tool industry, yet the general purpose machine tools such as centre lathes, drilling machines, milling machines etc., are still needed in growing quantities, even in the developed countries.

It is proposed that the developing countries should share in producing general purpose machine tools. This can be started by joint agreements

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between the developed and developing countries to the aim that the developed countries should have their needs supplied by the developing countries. The advantages of this proposal are:-

The possibility of increasing the quantity of each type of machine tool produced and therefore cutting production costs.

The possibility of exporting machine tools to the developed countries.

Increasing the technical "know-how" of the developing countries.

The developed countries would concentrate on the production of more complicated and precise machine tools.

The ties and co-operation between the developing countries should grow in the machine tool industry of the future.

U.N.I.D.O. Assistance.

Advice on the establishment of training centres and provision of experts to staff these in the initial stages, provision of an expert to study the problems facing the machine tool industry and advising on ways in which these can be overcome, providing expert advice on time and motion study, assistance in the establishment of a research and development centre for the machine tool industry together with full facilities for the manufacture of prototypes and machine tool testing, are some of the ways in which U.N.I.D.O. can assist the U.A.R.

The organisation could also assist by undertaking an expert survey to ascertain whether maintenance and rebuilding of machine tools in the country are adequate and in the light of this report advising on other steps which should be taken to improve the effectiveness of the machine tool stocks of the country.

PRODUCTION AND IMPORTS OF MACHINE TOOLS

1962 - 1970

(Value in 000's L.E.)

Types	Imports					Production			
	1962	1963	1964	1965	1966	1967	1968	1969	1970
Centre lathes	328	211	136	274	170	348	525	568	795
Turret lathes	37	23	49	104	194				
Others	8	56	24	58	45				
Total	373	290	209	436	409	348	525	568	795
Bench drill	29	18	16	33	12	34	54	52	75
Piller drills	11	6	12	8	6	76	95	76	92
Radial drills	25	7	16	67	49				
Others		17	1	15	8				
Total	65	48	45	123	75	110	129	129	167
Shapers	14	2	8	24	16		20	84	72
Planers	6		1	2	8				
Others				5					
Total	20	2	9	31	24		20	84	72
Milling M/C's	82	32	166	132	127		21		63
Grinding M/C's	47	30	53	122	65			6	28
Sawing M/C's	13	16	1	51	10				
Total	142	86	220	305	202		21	6	91
Other types & capacities	457	1156	1114	1379	1 [illegible]				
GRAND TOTAL	1057	1582	1597	[illegible]	[illegible]	[illegible]	695	786	1[illegible]

HUNGARY

Status of Machine Tools

Details of production imports and exports of machine tools, together with the total current stock of machine tools in Hungary, is given in the appendix from which it will be seen that 115,000 machine tools are currently in use. The majority of these machines are universal types, but in later years an increasing number of specialized types of machines have been introduced. Some 60% of the machines have been manufactured in Hungary and the average age corresponds to the international one except in the case of finishing machines, where the average age is little more than six years. Machine tool production first commenced in Hungary in 1872 and was well established by the end of the nineteenth century. At the present time, the total output of the Hungarian machine tool industry is about 20,000 units and on this basis Hungary is 15th on the World list of machine tool producing countries. Some 95% of the total production is produced by eleven factories, which are supported by seven further factories producing ancillary equipment such as hydraulic units, tools and machine elements. An Institute, which provides centralised facilities for research, development and testing and for investigating technological problems of the machine tool industry, is attached to one of the largest organisations. In addition to this, there is a second Institute concerned with developing electric automatic units and numerical control systems. In addition, the two Technical Universities and two Technical High Schools, assist the machine tool industry by undertaking machine tool research projects.

75% of the machine tools produced are normal metal cutting machines in the light and medium weight category and 10% are metal forming machines. The industry produces 145 basic types of machines, including lathes, milling

machines, drilling machines, grinding machines and other cutting machines including midget modular units, spark erosion machines, special purpose machines and production lines. In addition to these, a wide range of metal forming machines are also manufactured. In recent years, programme controlled and numerically controlled machines have also been added to the range, including programme controlled milling and turning machines, automatic cycle universal cylindrical and internal grinding machines and numerically controlled turret lathes, high precision boring lathes, chucking lathes, milling machines, jig borers and machining centres.

Fully automated production lines for machining bodies and end covers of electric motors at the rate of 3,000,000 per annum have been constructed. In the future, it is planned to introduce numerically controlled machining systems to meet technologically higher requirements and are suitable for machining groups of similar parts. The proportion of high accuracy and special purpose machine tools is steadily increasing especially in the export field. In addition, there is a steadily increasing international demand for more machine tools which are tooled-up and fixtured for the production of specific parts. The requirements of the user industry encourage the machine tool manufacturers to widen the selection of machine tools, while at the same time the economic factors indicate that the range of machines offered should be narrowed. To facilitate production, considerable attention is given to the development of "families" of machine tools of similar type to enable a large proportion of identical assembly units, components and standardised machine elements to be employed.

The number of machine tools to be produced in 1980, will not increase greatly above the present level as it is anticipated the product structure will change towards the more complex types of machine tools.

External Technical Assistance

The Hungarian Machine Tool Industry recognizes that it is not practical for one country to develop all types of machine tools and has therefore bought licences for machines such as the Matrix thread grinder, the Matier Forest numerically controlled milling machines and machining centres and the Zechokke edge bending machine. It is intended to speed-up the product development by further buying of licences and several machine tool companies are in successful co-operation with important West European machine tool works. This traffic is not entirely one-way, as Hungarian companies have sold licences for one of their machine tools to be built in Switzerland and Turkey. Further negotiations are in hand concerning selling licences with several companies in Latin America and Asia. Hungary is also ready to enter into mutually favourable relations with other developing countries to help the development of the machine tool industries in those countries. Successful bi-lateral co-operation between Hungary and other C.O.M.E.C.O.N. countries in many research and product developing themes. Some of the most important being, developing of N.C. systems and their building units, production systems and associated conveyor systems, computer aided programming and design, tooling systems for N.C. machines, high accuracy grinders and turret lathes.

Employment and Utilisation of Machine Tools:

The Hungarian machine tool industry is reviewing the character of components of centralised and specialised production of groups and parts, using the most advanced manufacturing methods. They are also continuing the development of their computer-aided data processing systems to ensure the optimum utilisation of machine tools by means of an effective production organisation. It is considered that the quality control is adequate in the machine tool factories. By means of regular inter-production

control and the thorough control of units and the finished machines, they ensure that the accuracy of the machines meets specification. The acceptance tests of the machine tools are carried out both statically and dynamically. In addition to this, fatigue tests are done on some of the machine tools selected out of the series. The mounting and final inspection of the high accuracy machine tools are carried out in air conditioned shops. In addition to these there are air conditioned measuring rooms for measuring parts of higher accuracy.

The machine tool industry is endeavouring to meet the demands of the user industry to obtain optimum utilization from their machines. The industry maintains close relations with their customers, giving technical advice, offering a wide range of accessories in order to increase the field of utilization and where necessary, supply machines already tooled-up for specific manufacturing operations.

Maintenance and Re-building.

Considerable importance is attached to adequate maintenance. In addition to this, the machine tool industry re-build 6% to 8% of their machine tools annually according to a programme which lays particular emphasis on the bottleneck machine tools used at the plant. Machine tool manufacturers also undertake re-building for their customers. However, to meet the increasing demand for machine tool re-building, a company has been established which undertakes the re-building of foreign and Hungarian built machine tools.

Introduction of Numerically Controlled Machine Tools.

In 1967 a representative plant of N.C. machine tools was established in Csepel Machine Tool Works, comprising 5 N.C. lathes, 2 N.C. milling machines, 2 N.C. boring machines and 1 N.C. drilling machine. The aim of

this representative plant is to supply the Hungarian metal working industry direct with workshop experience in introducing N.C. techniques, to establish the ways and methods of workshop and labour organization best fitted for N.C. and to provide a basis for the practical training of the specialists for complex automation.

Hungarian built N.C. machines will shortly be available with Hungarian control equipment, or alternatively imported control systems. The production costs during the initial introduction of N.C. machines utilisation are higher than conventional machines and in consideration of these factors the State affords support to those enterprises establishing N.C. machine groups. This support is available to those companies whose production range offers reasonable possibilities for the economic use of N.C. and who will undertake continuous and planned operation of the N.C. machines of at least 5,000 hours of productive running of each machine per year.

State Assistance.

In the interest of the technological development, State supervisory authorities give financial assistance to the companies to get machine tools and equipment of advanced types. In addition to this, the authorities penalise those companies which install or neglect to scrap old machine tools which preserve outdated technology.

Education and Training.

The machine tool factories regularly undertake their share of practical training of apprentices, thus giving young people the opportunity to become skilled workers. In addition to training of apprentices vocational education is given in special secondary schools which contribute to the training of future craftsmen. Young people from these schools become skilled workers or technicians depending on their inclination and practical ability. Classes are

organised for adult unskilled and semi-skilled workers.

Assistance required from U.N.I.D.O.

It would promote the development of the Hungarian machine tool production, if U.N.I.D.O. organized study tours into the developed countries and gave scholarships to experts to study the following subjects: Metal forming technology, foundry technology, forging technology, abrasive material and grinding wheel technology, organisational problems concerning the introduction and use of N.C. machines, organisation of production and the mechanisation of administration, computer-aided design and mechanisation of engineers work, techniques used in modern research institutes.

STATUS OF MACHINE TOOLS

Years	Number of Machine tools produced	Number of Machine tools imported	Number of Machine tools exported	Stock of Machine tools
1960	12,238	3,098	4,470	85,068
1970	19,470	1,307	4,559	114,[illegible]
1980	21,700	1,850	4,860	134,000

A. Milling Machine Tools.

1960	1,176	498	990	7,990
1970	1,042	162	603	10,199
1980	800	200	500	10,500

B. Drilling Machine Tools

1960	3,054	303	1,001	15,790
1970	4,120	145	1,095	23,631
1980	3,900	150	1,000	30,000

C. Lathes

1960	2,729	989	1,453	20411
1970	3,395	390	1,720	24,237
1980	3,000	300	1,600	25,000

D. Grinding Machine Tools

1960	2,422	376	225	15,699
1970	3,010	303	347	21,977
1980	3,000	300	400	26,000

E. Presses

1960	1,059	391	807	11,381
1970	981	195	11	12,439
1980	900	200	60	12,500

F. Others

1960	1,798	341	594	13,617
1970	6,914	152	783	22,349
1980	10,100	300	1,300	30,000

IRAN

Status Of Machine Tools.

The results of a recent census of machine tools are not available but the figures for the imports of machine tools for the years 1965 - 1969 are given in the appendix. From these figures it will be seen that in 1969 2,232 machines were imported. As the level of imports over the period 1965-1969 were reasonably consistant, it may be assumed that the total stock of machine tools in the country was in the order of 30,000.

The Engineering Industry.

The Iranian mechanical engineering industry can be divided into three main groups:

(a) Government owned industry controlled through the Industrial Development and Renovation Organization of Iran (I.D.R.O.)

(b) Large engineering enterprises which in the majority of cases have been set up in collaboration with a major foreign company specialising in the field concerned.

(c) Small scale engineering shops employing only relatively few operators, usually located in primitive premises, these are commonly referred to as the 'bazaar industry'.

Statistics of the Engineering Industry.

I.D.R.O. was established by Act of Parliament in 1967 and in the engineering field controls four companies each of which, at the present time, is due to commence production in the near future. The effect of these companies on the industrial life of Iran when they do become operational will be of tremendous magnitude. The four companies concerned are:

1. Tabriz Metallurgical & Engineering Plant Inc. (Machine S.A.Z.I.)
   This plant will manufacture machine tools, electric motors, pumps and small diesel engines.

2. Iran Tractor Company Tabriz.

This plant is scheduled to manufacture in the initial phase [illegible] tractors of 65 h.p. per annum. Ultimately, the plant is scheduled to increase production to 10,000 tractors per annum. These tractors are manufactured under a licence from Rumania and are of a very antiquated design. It is understood that investigations are being made into the possibility of manufacturing a tractor of modern design.

3. Arak Machine Building Plant Inc.

The plant is located at Arak and has been constructed under Russian technical guidance and is entirely equipped with Russian plant and machinery. The buildings are of extremely heavy construction and it has therefore been decided that some of the lighter fabrications which were scheduled to be produced in the building should be eliminated in favour of heavier types of equipment. The company is scheduled to manufacture pressure vessels, belt conveyors, mine cars, steel bridges, package boilers, heat exchangers, equipment for the food and sugar industries, lift crabs for cranes, construction earth moving and road making machinery, technological structures for petro-chemical industries, steel and iron castings, manganese steel balls and pressed steel parts.

4. Iran John Deere Company.

This company will manufacture agricultural implements and industrial equipment to the design of the John Deere Company of U.S.A. The plant is located in Arak adjacent to the Arak Machine Building plant. The operation will be principally one of assembly in the early stages but it is anticipated they will ultimately take a considerable volume of fabrications from their neighbour company

The sector of private industry associated with foreign partners includes companies such as Mercedes Benz, Leyland, Dorman and S.K.F. which are recently established major manufacturing operations. There is also major assembly

operations with limited local manufacture by companies such as Chrysler (Hillman) and American Motors (Rambler). Production of consumer durables such as refrigerators, air conditioners, etc., is also undertaken using imported compressors and electric motors but locally manufactured housings and other components.

The other section of private industry, generally referred to as the "bazaar industry", covers many thousands of small companies which are often no more than single rooms on the main streets of the towns.

The establishment of the training centres and the development of the large State owned industries will undoubtedly appreciably assist the development of this sector of small private industry. The State companies will need to purchase many items from local suppliers and will establish higher standards of quality than hitherto existed. Furthermore, a great number of the trainees from the schools will ultimately find their way into the small private companies. It has already been noted that some of the students in the industry training schools come from good local families who undoubtedly intend ultimately to set up in the engineering industry on their own account.

In the short term this may not be helpful to the establishment of the State companies but undoubtedly it will be of considerable benefit to Iran, they will have been trained to much better standards of quality and workmanship, to the use of standards and accurate measurement, and it is hoped, in the proper maintenance of machine tools.

The small companies normally employ less than 10 men and may only use two or three machine tools. There are no reliable figures as to how many companies exist but there are certainly several hundred and the total number of machines in use is greater than those in the very large new companies.

The possibility of assisting them with a rebuilding centre to restore their machines to original accuracies and productivity should certainly be investigated.

Machine S.A.Z.I.

As this company is the only one scheduled to manufacture machine tools in Iran it is given special attention in this report. Brief details of the company employment, capacity and proposed product range in the machine tool field is given in Appendix 'B'.

Production has been organized in the Company on the basis of producing specified types of parts within each section of the factory, the system often referred to as family grouping, whereby all shafts, for instance, are produced in one section and all gears produced in their own section from the raw material stage to the completely finished component. Exceptions are however, to be made in the case of the production of electric motors which will be produced in a self-contained section of the shop.

The machine tools to be built by the Company are to the designs of T.O.S, of Czechoslovakia and these therefore, have the advantage of having been proved in operation. All jig and fixture designs are available, together with all production method data. Supply of materials apparently is however proving particularly difficult, especially where limited quantities of special steels are needed and in the case of the many small factored parts which in an industrialised country could be easily purchased from many local sources.

Supplies of cutting tools are also reported to be difficult as the volume of their requirements are still unknown and especially with trainee labour, breakages are liable to be at a higher rate than normal.

The potential of this plant is very considerable but the management are facing considerable difficulties. Many of the machines have already been

installed for twelve months but there is no prospect of them commencing productive operation in the immediate future. The very scale of the undertaking might daunt even experienced management however, the determination to succeed exists so that, provided the right assistance can be given, volume production could commence quite rapidly. The machine tool manufacturing industry does incorporate many problems which do not occur in other parts of the engineering industry so that some of the advisers should be fully experienced in machine tool production. It has been suggested that U.N.I.D.O experts should be made available to provide assistance in the areas of:-

Industrial Engineering.

Production Engineering.

Quality Control.

Tooling Design and Production.

Marketing.

Financial Administration and Control.

Education and Training.

Primary education covers a period of six years and the majority of boys undertaking work of an unskilled nature receive no further education. Those who receive a further three years of secondary education can expect to be trained for semi-skilled and skilled jobs, while those who complete a total of six years secondary education can expect to be trained as technicians.

A large number of students continue to University (ten universities in Iran) and it is stated there is no shortage of qualified engineers, whereas a much more serious shortage exists at technical level.

Both at Machine S.A.S.I. Tabriz and the Machine Building Plant at Arak, top grade craft and technical training schools have been set up. There are places for 240 boys at Tabriz and 400 at Arak. Sections for

training on each class of machine tool, together with fitting and maintenance training as well as foundry and forging practice are carried out by these schools. The one at Arak, which was set up by the Russians and the local instructors trained by Russian instructors, is extremely good. Above the workshops at Arak, lecture rooms have been provided and these are equipped with all appropriate models for the subject covered by the lectures in that room. The students spend alternate days in workshops and theoretical studies. It is usual not to take boys for training until the age of 18, as below this age they are considered too immature to assimilate the training quickly and permanently. The training covers a period of either one or two years, depending on the class of work or the responsibility which the student will be expected to undertake. Military training for these students is postponed until completion of their course and is then restricted to six months instead of the usual two years. Graduate students are considered to lack practical training and to have an excessively theoretical approach to the problems which are presented to them. There appears therefore, to be definite scope for a suitable training programme in order to effectively integrate students into industry before they are allowed to undertake management responsibilities.

Machine Selection.

There is a definite need to establish a centre where technical information can be given and full library facilities set up, covering the complete range of machine tools which may be required in the country and the various sources of supply for such equipment.

It is not suggested that such centres would in any way eliminate the normal relationship between the purchaser and the domestic or foreign supplier of machine tools and other productive equipment. The function of the centre would be to ensure that the user was able to establish contact with every

possible supplier of appropriate equipment and thereby ensure that which was most suitable for the particular requirement was obtained.

Market Research.

Machine S.A.Z... claim that they have an effective market research section and that a scientific assessment of the market requirements was undertaken before they decided on the types and models of machines which should be manufactured by their Company.

It is important to realise that market research in the capital goods industry is a very sophisticated operation and cannot be based on using statistics covering machine tool demand in earlier years but the rapidly changing technological requirements make it important that the right decisions should be made, if a company is not to be committed to the heavy expenditure in tooling-up for a new model for which there may be little or no demand by the time production commences.

Machine Tool Maintenance

It is understood that both at Arak and at Tabriz the Russian and Czechoslovak suppliers of the machine tools have provided details and precise instructions for programmes of preventative maintenance on all the machines supplied.

As all the machinery in these plants is new, the equipment should remain in excellent condition for a considerable number of years provided the instructions from the suppliers are strictly adhered to. The other large engineering companies, due to their foreign connections are likely to be pursuing adequate maintenance programmes. The difficulty exists with the small companies where maintenance is likely to be of the most rudimentary kind and the condition of most machines at best is doubtful.

Educational programmes are unlikely to influence these companies at

the present time but in the long term the large engineering organisations recently established should have a considerable influence for the better on the small companies. As reported elsewhere, it is likely that a number of the trainees from these new organisations will subsequently move into the small scale industry and the practices which they have learned in the new companies will therefore be widely felt throughout the Iranian industry. For this reason, it is vitally important that the new organisations should tackle the requirements of machine and equipment maintenance on a fully scientific basis.

Industry Protection.

An embryo machine tool industry will certainly be in need of Government protection during its early years if it to have a reasonable prospect of success and become viable. It is understood that at the present time the following charges apply to imported machine tools:-

Customs Duty	10%
Commercial Profits	5%
Bonus on Export	1½
Insurance	1%
Bank Charges	½%
Transport to Djulfa	½%
Other charges	2%

However, on purchases by Government establishments, the first two items are omitted.

These rates do not appear to provide the protection which will be necessary to support the company until it has become productive and efficient and be able to withstand reasonable competition from third countries.

Measures to be taken for safeguarding Machine Tool Industry.

1. By the government

(a) To ask the assistance of foreign experts especially U.N.I.D.O. ones when installing new machine tool factories.

(b) To limit or stop the importation of similar products to the products

manufactured in own factories. It goes without saying that this limitation should be in such a way the manufacturer is not allowed to decrease the quality level of his products.

(c) To facilitate the importation of raw material and components for manufacturers through decreasing of Customs duties and other costs.

(d) To try to come to some regional agreements with other developing countries, helping each other in creating wider markets.

(e) To encourage and help private sector in installation of auxiliary industry and thus helping masterindustry with locally covering its needs for purchased parts and components.

(f) To see to the training of the technical and management staff needed for industries, through arranging suitable practical trainings parallel to theoretical onesat universities and institutes and also sending trainees to developed countries to gain practical experience in respective fields and professions.

(g) To try to establish a more or less unified system of wages and salaries on a country level to prevent the creation of special attracting poles in some places.

(h) To establish an industrial standardization as a guide line for systematic development of industries and as a common tool for eventual co-operations between different industrial units.

(i) To have long term industrial development plans and foreseeing of all necessary steps to be taken for realization of these plans.

2. By the factories themselves:

(a) To select the products to be manufactured, suitable technology and machinery after a deep study and asking technical assistance of foreign and especially U.N.I.D.O experts.

(b) To employ experienced people and see to their continuous training in respective fields.

(c) To make use of experienced experts of developed countries, at least during the first five years from putting the factory in run.

(d) To see to the important task of production planning activities with regard to a good market research and also capacity loading of production facilities and human factors.

(e) To be careful in optimum choice and consumption of material.

(f) To try to create a suitable relation between the number of direct production workers and the other indirect staff in order to decrease the indirect and overhead costs.

(g) To see to the economic consumption of different kinds of energies.

(h) To take care of planned preventive repairs of machinery and equipment, thus preventing unsuitable interruptions in production processes and increasing the lifetime of production facilities.

(i) To take a special care of the quality inspection of manufactured parts and final products.

(j) To establish organizational rules and principles for smooth and proper running of the factory.

U.N.I.D.O. Assistance.

The areas in which U.N.I.D.O. could bring immediate benefit to the machine tool manufacturing capacity of the country lie principally in the following areas:-

1. Assistance as enumerated earlier which is required by Machine S.A.S.I.
2. The establishment and adoption of machine tool standards, including machine acceptance standards.
3. Market research needs to be conducted on a much more scientific basis.
4. Practical training of Graduate Engineers and their integration into the engineering industry.

IMPORTATION OF MACHINE TOOLS IN YEARS 1965-1969

Types	1965 pcs.	1966 pcs.	1967 pcs.	1968 pcs.	1969 pcs.
Lathes	993	882	1,157	1,272	999
Drilling machines	279	444	752	604	230
Grinding machines	444	311	1,058	652	692
Milling machines	13	10	21	35	44
Presses (except hydraulic)	165	248	264	327	267

Tabriz Petrochemical Engineering Plant Inc.

(Machine Making)

Total Employment 2,167

Trade	Gen. Management	Financial Div.	Commercial Div.	Technical Div.	Production Div.	Personnel Div.
Technician	55	16	42	104	124	22
Main. Worker	11	50	41	19	16	17
Direct "	-	-	-	-	948	-
Indirect "	84	-	115	338	245	69
Apprentices	-	-	-	-	-	230
Totals	140	66	198	460	1,373	339

Foundry - Capacity:

Grey Iron	10,000	Tons p.a.
Non-Ferrous	200	" p.a.
Steel Castings	100	" p.a.
Forgings	700	" p.a.

Total Investment:

1.Rials 5,500 M. (U.S. $ 80 M.)
incl. Working Capital.

Cost of Machinery & Equipment:

1. Rials 1,600 M. (U.S. $ 23 M.)

Total No. of Machine Tools installed: 600 - includes 70 in Training School

Productions:

Electric Motors	50,000	- 1.1 to 10 K.W.
Small Pumps	8,000	
Small Diesel Engine.	Future Product.	
Machine Tools	1,500	
Lathes SU 40 & 50/2000	500	p.a.
SU 630/2000	50	p.a.
Milling Machines FA3A	100	p.a.
Horiz. Vert & Universal		
Shaping Machines 40A & 63A	100	p.a.
Drilling Machines:		
Bench 4 sizes	325	p.a.
Column 2 sizes	125	p.a.
Radial 1 size	50	p.a.
Double ended floor		
Mounted grinder 2 sizes	1,000	p.a.
Presses Excentric		
2-40 & 63 tons	350	p.a.

Total No. of Workers and Technicians Trained in school up to 1971 - 550

Total No. of Engineers, Technicians and Workers trained in Czechoslovakia .-

Status of Machine Tools in Iraq.

Iraq is one of the developing countries which is not steering any machine tool industry, either in government or the private sector. Regarding the existing stock of machine tools in Iraq, there is no statistical data related to this subject and it is rather hard to collect such data in the short time available.

Visits were made to the principle metal working industries and training centres in Iraq and from these visits, together with other statistical information available, the following figures have been compiled:

Railway Workshop, Baghdad.	704	machines
Transport administration Workshop.	58	"
State Mechanical Industries Co. Iskandyria.	697	"
State Electrical Industries Co.	169	"
Training centre of National Oil Co.	58	"
Recently established technical and vocational schools - total of 11 schools	280	"

Beside the above mentioned, the industrial statistical survey of 1968, showed that there are 1,435 industrial establishments, of which 226 are in the metal working industry. On the assumption that each of these metal working industry shops have three machine tools on average, the total will be 678 machines. If it is further assumed that the rest of the other industries have one machine tool each, the total will be 1,209 machine tools. To this must be added certain machine tools in other training establishments which brings the grand total to 3,367. The summary sheet for stocks and imports, including estimates for 1980 is given in the appendix.

State Company for Engineering Industries, Iskandyria.

The majority of machines at Iskandyria are standing idle and it is difficult to reconcile the figure of 1,800 shop floor workers with the appearance of the factory, even when those working in the foundry have been eliminated. The machines are stated to have been manufactured in 1961,

although kept in a warehouse since that date [illegible] pending the completion of the buildings. In spite of the very short period of time in which these machines have operated, breakdowns are [illegible] be frequent and a major programme of [illegible] initiated. They state that no programme for preventative maintenance was provided by the Russian consultants when setting up the factory, nor have recommendations for spare parts been given. The Maintenance Engineering Department report that they, in conjunction with the Russian advisers are now studying the Spare Parts Manuals for the machines with a view to compiling lists of likely requirements in the future and in many instances it is proposed that these parts should be made at the factory rather than importing from the original machine supplier.

<u>The Electric Manufacturing Company</u>.

This company which has been operating for five years, is producing a considerable volume of the product range selected. There is however, considerable under-utilisation of plant caused by:-

(a) The plant being designed to produce not only fractional horsepower motors but electric motors up to 50 horsepower;

(b) The use of outdated methods of manufacture and unsuitable machines for certain of the operations performed.

<u>Railway Workshops, Baghdad.</u>

These workshops were established when the Railway was first built and with the exception of a new shop for the servicing of diesel locomotives and also one for carriages, which is just on the point of completion, the premises and equipment are extremely antiquated. The newest machine tool at the present time is approximately 15 years old whereas the majority range from 20 to 50 years old. A complete new installation however, for wheel turning is due to be introduced shortly and it is stated that this new section will be five

times as productive as the present set up. While the conditions of operation are antiquated in the extreme, there is undoubtedly a very high degree of skill exercised by operators and supervision alike. The general care of the machines is in the hands of the operators and they clearly take a great pride in keeping it well cleaned and oiled and in the best condition within their capability. There is however, no planned programme for preventative maintenance and repair work is only undertaken when the machine actually fails.

Transport Equipment Workshops.

The machine shop is comparatively small as the majority of the work is carried out in the fitting shops where vehicles are stripped down and rebuilt primarily using replacement parts from the original manufacturer. They do however, undertake the metal spraying and regrinding of crankshafts and reboring of engines, as well as the limited manufacture of parts which are not readily available from the equipment makers.

Small Companies.

Driving down the main street of the engineering district, it is possible to observe several hundred machine tools in the open fronted workshops. Most of these shops only have two, three or perhaps four machines operated by the owner and his friends or family. The majority of these machines are extremely antiquated but occasionally, machines of less than ten years of age are to be seen. It is reported that there is a high degree of skill in these shops but this statement should be treated with reserve.

Training Centres.

There are three principal training centres established or in course of construction. The oldest of these is the Railway Institute which has

been in operation for five years and is equipped with some forty of the tools of modern design. The emphasis at this centre is on practical work rather than theoretical studies which only account for a small part of the total curriculum.

The Oil Company at Baghdad have established an extremely modern training centre equipped with first class machine shops and excellent lecture rooms with all necessary models provided. The centre is due to become operational in the Autumn and a number of Russian instructors will be attached to it.

The third centre is at Iskandiyia but the buildings for this centre are only in course of construction although the machine tools have already been delivered and are in store at the main factory.

Each of these centres will play an important part in training the technicians and artisans for the industrial development of the country and it is important that machine tool utilisation and maintenance should be included in the curriculum.

Training Schools.

Eleven technical and vocational training schools are being established and on average each of these schools have around 25 machine tools. I.L.O. guidance is being given in the establishment of the training methods and curriculum.

Machine Tool Rebuilding Programme.

Due to the age of many of the machines at the Railway Workshop, these have become inefficient but for the class of work being undertaken, would be fully restored if a major rebuilding programme was undertaken. It is suggested that advice on the most suitable method of conducting a rebuilding programme to cover such a wide range of machines, would be extremely helpful. In many instances the work performed could not justify the cost of more

modern types of machine tools and the skill for operating these machines, as well as the skilled fitters for a rebuilding programme are available, although guidance would undoubtedly be needed.

Preventative maintenance.

At both Lehandyrie and the Electric Manufacturing Company, there is an urgent need to set up an effective preventative maintenance programme if serious damage to the machinery not to be incurred. The utilisation of machines at both these establishments is of a very low order.

Adaptation of machine tools.

There is a very real need for a body to be set up to give advice on the selection of machine tools as individual companies do clearly not have expertise to undertake this work. The Industrial Research and Development Institute for engineering industries in Ireland may be a suitable body to undertake this work provided it was suitably staffed.

Numerically controlled machines.

The benefits which can be derived from the simpler types of numerically controlled machines, such as vertical drilling machines, are not fully understood. They have been regarded as a product purely to be used by mass production industry in the highly industrialised countries. The fact that an N.C. drill is invaluable in a batch production shop by eliminating the need to make large quantities of expensive jigs and the flexibility of design changes which this brings about, have been completely overlooked.

Many components which could have been cheaply and quickly machined on an N.C. drill were being laboriously and at enormous cost produced on jig boring machines. Furthermore, the improvement in reliability and the simplification in servicing requirements which have resulted from developments in the electronic field in the past few years has not been noticed.

A U.N.I.D.O. project for the education of [illegible] in this topic could do much to facilitate improved efficiency and reduce [illegible] on foreign supplies in these countries.

Tool Grinding

A great deal of education is still required in this area as the standard of tool servicing generally leaves much to be desired. Increased production could undoubtedly be obtained from many of the machines if better quality tools, properly serviced, were utilised. Feeds and speeds being used were normally much slower than one would expect to see in an industrialised country, due either to the tools not being capable of operating faster or, where the tool was properly ground, to a desire to prolong the life to the maximum before regrinding would be necessary.

Development of Engineering Industry

The most urgent problem at the present time, is to get the two major State owned industries into effective and economical production. The problems at both these plants is principally organisational and administrative. A small team of experts, with experience in operating plants of these types is urgently required to get them into effective operation. These two plants form such a high percentage of the total engineering industry of the country, that it is of paramount importance that every effort should be made to bring these schemes to a successful conclusion. The spin-off from these plant operations will have a considerable effect on the engineering industry of the country as a whole so that all efforts should be concentrated in this direction.

Assistance from U.N.I.D.O.

1. Organisational and administrative experts to advise on the operation of the two major engineering factories.

2. Training of engineers in maintenance.

3. Training engineers in design and manufacture of dies, jigs and fixtures.

4. Provide an evaluation programme to show advantages of numerically controlled machines for batch production. Provide training facilities for programmers and other supporting staff.

THE FOLLOWING TABLE SUMMARIZES THE
STATUS OF MACHINE TOOLS IN IRAQ.

Years	Number of Machine Tools Imported	Stock of Machine Tools
1960	200	
1970	420	3,367
1980	660	

A. Milling Machine Tools

1960	8	
1970	19	133
1980	27	

B. Drilling Machine Tools

1960	21	
1970	44	352
1980	69	

C. Lathes

1960	111	
1970	233	1,871
1980	366	

D. Grinding Machine Tools

1960	11	
1970	24	193
1980	30	

E. Presses

1960	24	
1970	50	409
1980	80	

F. Others

1960	25	
1970	50	413
1980	80	

Status of Machine Tools

Details of the machine tool production, imports and stocks of machines in Israel are given in the appendix, together with a separate table, outlining the industrial capacity and employment for industry as a whole, for the metal industries, electronics and for the machine tool industry. From these figures, it will be noted that while in 1960 machine tool stocks were only 12,200, they had increased to 45,000 by 1970 and are expected to again quadruple by 1980 to a 185,000 machines. Machine tools manufactured in the country have increased from a negligible 350 per annum in 1960 to 2,100 by 1970 and this figure is expected to increase six-fold by 1980. It is significant that, in spite of these large increases in locally produced machine tools, imports are also increasing rapidly.

Employment in the machine tool industry is expected to increase by 20% per annum during the period 1970 - 1975 compared to 7.2% for the metal industries and 4.7% for industry as a whole.

Output for the machine tool industry during this period is expected to increase by 23.6% per annum.

The Metal Working Industry.

With the high rate of machine tool absorption into this sector of industry, it is clear that very rapid expansion will take place. To assist industry in maintairing and improving its efficiency, the Israel Institute Of Productivity incorporates a body known as Automation Institute Of Israel. The proposed future structure for this body is made up as follows:

(a) The Industrial Automation Department.

This is an already existing department which should be expanded for further development and application of automatic actuation and control systems in (existing) operations in the manufacturing industry. Characteristic for this department is that it assists

industry in developing "tailor-made" automatic systems by using a wide range of standard general-purpose components.

(b) The Numerical Control Centre.

A not-yet-existing department to assist manufacturing industry in the preparation for, introduction and successful utilisation of production and inspection means and methods which are based on Numerical Control (N.C.)

(c) The Process Control Department.

A department for the development and application of automatic control systems in (continuous) operations in the process industry. This department has been established recently and is still in the take-off stage.

(d) The Automation Management Department.

A not-yet-existing department to assist management in industry in preparing for and implementing new concepts and technologies. This department is not meant to involve itself in introducing traditional management systems for which it should seek the co-operation of the department already dealing with this subject in the Productivity Institute.

Machine Tool Industry and Future Policy.

At the present time, the machine tool industry is manufacturing bench and pillar type drilling machines, two sizes of lathes under a "know-how" agreement with T.S. Harrison and Son Limited of England, bench and pedestal type grinding machines and tool sharpening machines, eccentric presses from four to forty tons and hydraulic presses as well as presses to the design of the Bliss Company of America up to four hundred tons. Sheet metal working machines, in the form of guillotines, power brake presses and plate bending rolls are also manufactured. Recently, manufacture commenced of a small B.M.K. drilling machine.

Following the government plan for the industry's development for the years 1970-1975, as a part of a larger plan for the whole decade, Israel will go on in its present line of machine production. In the same time will be gradually introduced new types with carefully selected specifications the best fitted to its prevailing technological, social and educational situation and its high man-power quality level.

This policy tends to introduce in production more sophisticated units or its parts, specially on the middle size types.

It's obvious that for a long time Israel will still import the specialised and recently developed machines, especially the heavy duty types. Among these will be; Turret Lathes- Single and Multi Automatics - Universal, Plain and Vertical Milling Machines - Drilling Machines, Ultrasonic, Multispindle and Radial arm - Grinding Machines, Universal, Cylindrical, Surface and Centreless - Numerically Controlled Machining Centres - E.D.M. and E.C.M. (Spark Erosion and Electro-Chemical Machining.)

Notwithstanding the smallness of the machine tool industry, Israel has made dynamic progress in the same short period in a number of ancillary industries.

<u>Foundries</u>: There are approximately 10 large and medium size Grey iron, Steel and Stainless Steel foundries, besides many small shops. They all supply the present needs for cast iron for machine building. There is a very important plant that specialises in malleable cast iron, Steel castings and Ductanite castings.

<u>Forgings</u>: Another large plant specialises in hot forging of all kinds.

<u>Electrical equipment and components</u>: There are several important producers of electric motors to supply all machine tool needs, from fractional power up to 150 h.p. The same firms also produce electro-mechanical and electronic devices for machine control

Tool Industries: There are 10 important plants producing all kinds of tools. Turning and boring tools, milling cutters, face and end mills, twist drills, saw blades, grinding stones, a complete range of Diamond tools like Diamond grinding wheels, Diamond boring and turning tools and Diamond dressing tools. Some of the cutting tools are produced from HSS or are hard metal tipped.

Industry Protection.

Since the early 1960's the period of protectionism of the local manufacturer gradually came to an end. From then the import liberalization policy has included more and more products. Today, almost all imports are liberalised and open to free worldwide competition, accompanied by a gradual reduction of customs duties.

The first period of administrative protection necessary for a rising economy, made it possible for the new born industry to consolidate and develop. The present policy of liberalisation of imports has compelled manufacturers to rationalise their installations and production processes in order to improve quality and reduce prices.

During the mentioned period, the country succeeded in laying the foundations for a modern mechanical and electrical industry together with its technology, layout and skilled labour force.

Thus, Israel possess today a large number of factories producing agricultural machinery, earth movement devices, transport equipment, electric motors and transformers and electrical and electronic equipment. All this serves as a good basis to the development of a machine tool industry.

Co-operation and Technical Assistance.

A number of technical "know-how" and manufacturing licencing agreements

have been entered into with organizations in the developed countries. Israel is looking to entering into further bi-lateral assistance agreements for the development of new lines of machine tools with agreed market rights. It is suggested that U.N.I.D.O. should assist in undertaking surveys of priorities, advise on types of machines that will be convenient and suitable to produce and to propose foreign companies with whom co-operative agreements could be made.

Problems in the development and utilization of machine tools.

The production is organized on a modern technological basis but the small production runs tend to reduce efficiency. Quality control and testing are undertaken to the most stingent standards. In recent years, utilization has been improved together with better factory layout. Maintenance and repair work are undertaken on a systematic routine basis.

Introduction of Numerically Controlled Machine Tools.

The first N.C. machines were introduced to the country in 1966 and there are now some 45 units in operation. A yearly growth of between ten to fifteen units is anticipated. There is already a good team of qualified technicians to run and service these very expensive equipments and further teams are being trained.

Co-operation and Technical Assistance.

The country is ready to receive and absorb new technical assistance, looking for new ways of developing modern fabrications. There is plenty of room and possibilities to absorb technical assistance from U.N.I.D.O. such as surveys on priorities, types it would be convenient to produce; to propose an adequate foreign company for co-operation purposes.

STATUS OF MACHINE TOOLS

Years	Number of Mach. Tools Produced.	Number of Mach. Tools Imported.	Number of Mach. Tools Exported	Stock of Machine Tools	[illegible]
1960	350	3,750		12,2[illegible]	4,[illegible]
1970	2,100	10,000	700	45,000	11,[illegible]
1980	12,700	25,800	7,900	185,000	27,[illegible]

A. Milling Machine Tools

1960		50		40[illegible]	
1970		150		1,5[illegible]	1[illegible]
1980	200	800	100	5,0[illegible]	9[illegible]

B. Drilling Machine Tools

1960	10	550		1,800	560
1970	150	1,450		5,000	1,80[illegible]
1980	3,000	7,000	1,500	15,000	8,50[illegible]

C. Lathes

1960		150		6,000	150
1970	150	700		12,000	850
1980	1,000	2,500	500	35,000	3,000

D. Grinding Machine Tools

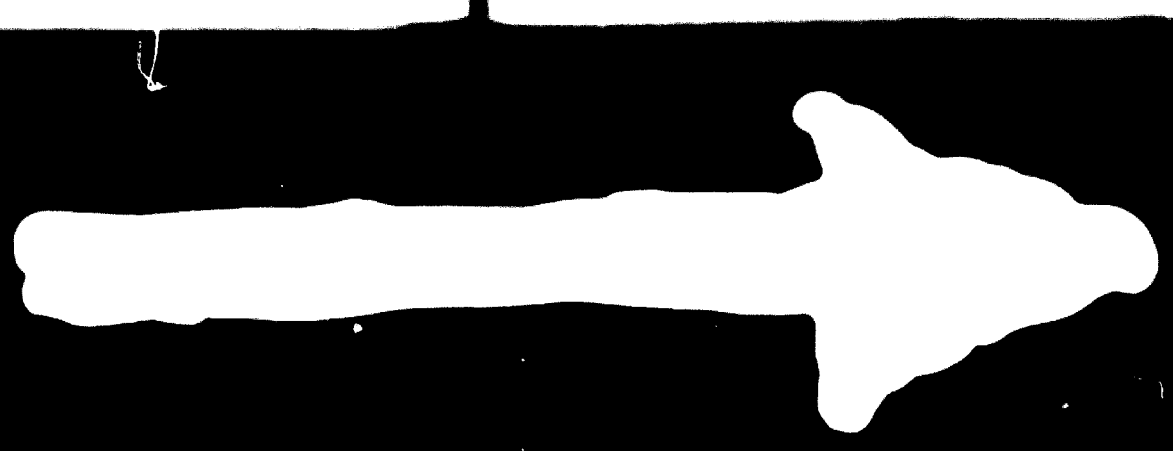
1960		800		1,000	900
1970	500	2,500		8,000	3,000
1980	3,000	6,000	2,000	15,000	7,000

E. Presses

1960	40	200		1,000	240
1970	300	200		2,500	400
1980	1,500	800	800	15,000	1,500

F. Others

1960	300	2,000		2,000	2,300
1970	1,000	5,000	600	18,000	5,400
1980	7,000	10,000	3,000	100,000	14,000



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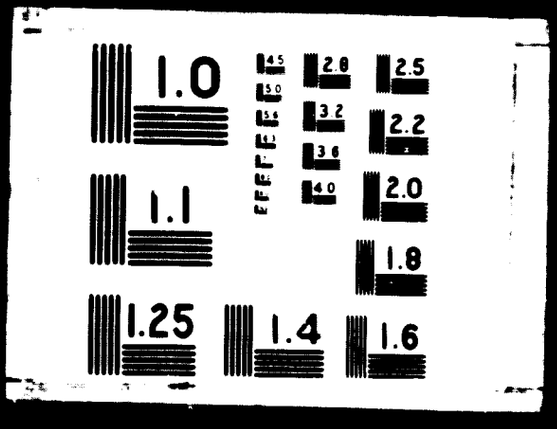


Appendix B.
Israel.

INDUSTRIAL CAPACITY AND EMPLOYMENT

Branches	Output (in millions of IL) 1969 fixed prices				Annual Average Growth Rates (%)		
	1955	1965	1970	1970	1955-1965	1965-1970	1970-1975
Total Industry	2,322	7,265	12,160	20,150	12.1	10.8	10.6.
Metal Industries and Electronics	365	1,743	3,530	7,205	16.9	15.1	15.4
Machine Tool Indus	0.3	1.8	6.0	18.0	20.2	23.8	23.6

Number of Employees
(1,000's)

Total Industry	127	220	280	352	5.6	4.9.	4.7
Metal Industries and Electronics	32.2	69.0	95.5	135.3	8.0	6.7	7.2
Machine Tool Industry	0.03	0.07	0.150	0.360	8.5	15.3	20.0

Output per Employee
(1,000 IL)

Total Industry	18.3	33.0	43.5	57.2	6.1	5.7	5.6
Metal Industries and Electronics	11.3	25.2	37.0	53.2	8.4	8.0	7.5
Machine Tool Industry	10.0	25.6	40.0	50.0	9.2	9.1	5.5

JORDAN

Status Of Machine Tools.

As no statistics have been made available regarding machine tool stocks in the country or the anticipated future demand, an indication of the possible machine tool consumption can perhaps best be obtained by considering the information we have on Jordanian industry. During the last few years, certain types of machines have been manufactured to meet the local demand. Efforts have been made to improve the designs and the quality of these machines in order to compete effectively in the local market with similar imported goods.

As is the case in other small countries where local consumption is very limited and means of transport for export is limited to road vehicles, the concentration is based on small scale industry for both local consumption and export to neghbouring countries.

In the drive for progressive economic development, the inhabitants of Jordan realise the extent of their responsibilities to work on more than one front, whilst being concious and deeply convinced of the essential necessity of industrialisation.

The last ten years have seen a rapid growth in economic development. The economic policy of the government and the seven year plan have contributed to this rapid growth which manifests itself in the increase and diversity of manufactured and semi-manufactured goods and gradual expansion in export.

Increasing public and private investment have brought about changes in the international structure of the economy, intensifying the activity of its various sectors and contributing to the general growth of the national income and the overall progress of the country.

The promotion and diversification of manufactured goods has been enhanced

in several ways, taking into consideration the needs and requirements of the local market.

As Jordan is developing its tourist industry, a lot of attention is based on the traditional handicraft industry.

The regular increase and the big demand for houses was the main reason to start machine fabrication in Jordan. Foundries were established to cast all sorts of stone crushers, tile making, Olive oil machines, centrifugal and vertical pumps, deep well Artesian pumps, reciprocating pumps etc. Most of these machines were manufactured to Italian design and were modified later to suit local demands.

The Industry flourished very quickly and some firms like messrs. Khalifen Bros. were able to export their machinery to Iraq and Kuwait. Because of the wide demand for this type of machinery, foundries were modified and are now able to make up to five ton castings for the tile industry and for agriculture. Machinery is manufactured in Jordan for Olive oil pressing which can handle up to 350 Kg./Cm^2. Stone crushers are also produced in Jordan on a large scale together with earth-moving dumpers. Centrifugal pumps are produced locally in more than one factory coupled to electric motors or deisel engines.

The United Industries are successfully producing wet car batteries which they are selling in the whole of the Middle East area. This plant is fully equipped to produce all parts required for its needs. Dry cell batteries are also completely produced in Jordan.

For the building industry, a complete range of sanitary fittings and pipes are produced for local and export markets. Cast iron manholes are widely produced to all specifications to meet the increasing demand of sewage works and treatment plants. The Industrial Company for Castings and Sanitary Fittings is the leading firm in this aspect, using modern moulding machines and complete production lines for this purpose.

The national income in 1962 was JD 129,000,000 and the estimated figure for 1966 was JD 185,000,000. The progressive expansion of industrialization continues to be a principle target for the government. Statistics indicate that there were 5,867 industrial establishments operating in 1966 but as there is no indication of the size of these establishments, it should be assumed that they are principally small-scale operations with one to five employees.

Government Policy for the Expansion Of Industry.

In order to assist local industry to compete with Europe in general, and the Socialist States in particular in the field of industry, the government issued a law entitled, "The Encouragement And Guidance Of Industry" and "The Encouragement Foreign Capital Investment." In 1966 an industrial development bank was established in Jordan, the main task of the bank being to give loans to all new industries which undertake projects that are shown to be feasible.

Capital investments by the public and private sector, running at a level of JD 18.7 millions in 1963 are scheduled to rise to JD 42.3 millions in 1970. In order to encourage foreign investment, the government guarantee to foreign capital, all the privileges and exemptions granted under the law and shall in no way diminish these privileges under any subsequent ledgislation.

Maintenance and Rebuilding.

No information is available on this subject but in view of the assumed small scale nature of industry, it is unlikely that any extensive maintenance programmes are undertaken or that any facilities exist for machine tool rebuilding.

Technical Assistance.

The government have indicated that they welcome co-operation with European Countries which may either be in the form of joint-venture operations or royalty agreements. It is suggested that U.N.I.D.O. should assist the Jordanian Government by undertaking a survey to advise on the most suitable types of industry that should be established and should then advise on the ways and means of establishing such industry.

A programme for the education and training of skilled workers and technicians, required by the expanding industry should also be prepared for submission to the government and where approved assistance given in the implementation of the programme.

If this does not already exist, an industrial testing and research centre should be established with U.N.I.D.O. assistance in order to help industry to improve the general quality of product. The centre should also become the focal point for the establishment of acceptance standards for machine tools which would be in line with international practice but adapted where appropriate, to local requirements.

KUWAIT

Machine Tool Utilization by Government of Kuwait.

Five ministries are using machine tools on a fairly large scale in Kuwait, as outlined below:

1 - Ministry of Public Works.

The Ministry of Public Works started using machine tools in 1952 when a large fleet of road machinery was imported and a large transport section was founded. Then the necessity of machine tools for maintenance purposes was essential. This ministry now has a large number of centre lathes of various sizes and capacities, milling machines, shaping machines, crankshaft grinders, cylinder boring machines and oil engine overhaul machine tools.

2 - Ministry Of Education.

The Ministry of Education has the technical college. This college was founded in 1953 and has a fairly substantial number of machine tools for training purposes. Their shop is well equipped with centre lathes, radial drills, shaping machines, milling machines, grinders, etc. Students from secondary schools are accepted there and they will be employed by various technical ministries after graduation.

3 - Ministry Of School Affairs.

The Ministry of Social Affairs has an institute for training skilled labour in various trades and it has a machine tool programme to train artisans on centre lathes, shaping machines, milling machines and measuring tools. The training period is 18 months and graduates are mostly employed by government technical ministries. This institute was founded by the government of Kuwait and the International Labour Office of the United Nations. International experts are teaching the various trades with the aid of Kuwaiti instructors who have graduated from the same training institute. The management and administration

of the institute is carried out by the Ministry of Social Affairs.

4 - Ministry of Finance (Dept. of Customs & Port).

The machine tools in the Department of Customs and Port are particularly suited to the maintenance of marine work for ships, tugs and boats. Their workshops have large capacity lathes, shaping machines and large drilling machines, grinders, welding machines, etc. Besides marine works, they machine all parts involved in cranes, trailers and transport engines.

5 - Ministry of Electricity and Water.

The Ministry of Electricity and Water has the largest workshops in Kuwait and the Middle East. It's main workshop at Shuwaikh was founded in 1953, Basically for the maintenance of its first distillation plant and power station. Demand on electricity and water is rapidly growing as the country expands and develops. More distillation plants and power stations are being constructed and accordingly, the main workshops expand to carry out all the maintenance required by distillation plants, power stations and other sections of mechanical and electrical services. There are approximately 12,000 employees. Orders are executed by the main workshops 50% of which are executed by the machine shops. The machine shop is very well equipped with machine tools. Some are for general purposes and others are specifically for machining certain parts used in the Ministry's equipment.

Areas For Future Development.

Demand for die casting is becoming necessary in order to use various scrap materials, to expedite production of required parts and to save at least 50% of material wasted by turning processes and 70% labour costs.

Shaft rebuilding is also very important. Kuwait's problem is expensive shafts and crankshafts need rebuilding. These cannot be scrapped

due to the high cost of replacement. If they can learn this process and the "know how" they can purchase the machinery and rebuild those shafts where the defect is below the permissible grinding size on any journal or bearing seat.

For curing vibration troubles occurring mostly in electrical motors of 500 h.p. and over, there is a Hoffman balancing machine of 10 ton capacity and 20 foot length and 6 foot swing, purchased in 1958. False weights are used and work out corrections through long calculations. They try to smooth the vibration to the minimum or try to shift critical speed away fromstarting or running speed. Information is needed on an easier method, or new process to permit vibration analysis to detect causes on location, without dismantling rotors and transporting to workshops. In the balancing field, a universal driving coupling should be adopted to suit all diameter shafts instead of manufacturing a new coupling for each case to suit its original driving coupling which takes time and wastes material.

Regarding precision grinding finishes, this includes outside and internal grinding, more knowledge and training in this field is required. Also lapping machines to the maximum precision of nearly 0.0001" as this is required daily for various shafts, cylinders, sleeves, plates and valve reeds and seats, etc.

Private Sector.

In the private sector, the local companies are equiped with the machine tools necessary for its business or industry. As mentioned earlier in this report, each company has available the machine tools at the main workshop of the Ministry of Electricity and Water. Most of the oil companies and industry in the private sector get the technical assistance and use of

the machine tools in the main workshops, when requested and approved by the Ministry. As a short review of the local sector, there are machine shops for engine overhaul, aluminium industry, ironmongery, marine workshops, sheet metal workshops, steel furniture and wood working machinery.

Education and Training.

Most of the machine tools were operated by foreign technicians at the beginning. Now, by encouraging a policy of training, the Kuwaiti skilled labourers and technical assistants graduating from the technical college and the training centres, are taking their place in industry and over 50% of the machine tool operators and supervisors are local personnel. This training programme should be expanded and accelerated in order to meet the demand for skilled employees and to release the foreign artisans.

Maintenance and Rebuilding.

Most of the machine tools were apparently imported in the early 1950's and as these are by now nearing 20 years old, they must be overdue for rebuilding or replacement. Most of the machines are of the general purpose type and it would therefore, be logical to rebuild these rather than to replace them. It is therefore, suggested that a rebuilding centre should be established which in the first instance should be supervised by experienced foreign staff.

Technical Assistance.

From the report submitted, it appears that Kuwait could benefit considerably from U.N.I.D.O. assistance in the following areas:

1- Establishment of machine tool acceptance standards.
2- Preparation and implementation of machine tool preventative maintenance programmes.
3- Assistance in the expanding and upgrading of skilled worker and technician training programmes.

4 - Assistance with the establishment of an advisory service on machine tool selection to meet specific manufacturing or repair programmes.

5 - Assistance in setting-up a machine tool rebuilding centre and training staff.

PEOPLES DEMOCRATIC REPUBLIC OF YEMEN

The Metal Working Industry.

Very little industry exists in the country other than a medium sized B.P. Oil Refinery which comprises more than 80% of the industry. However, the draft of the 3 - year plan for the country, which has recently been prepared, lays great stress on the development of industry. Nearly £10 million i.e. nearly a quarter of the capital investment of the government in the plan, is to be allocated to the development of light industries. The plan includes the construction of thirty new factories, of which twenty-five are to be completed within three years from the date of commencement of the plan. These include factories for the manufacture of shoes, matches, cigarettes, plastic goods, ginning and weaving of cotton cloth and also a leather tannery, tomato puree canning factory and a fish meal factory.

The Country does not produce machine tools and the three year plan does not aim at doing so. They do not produce steel or iron ore and the plan does not provide for factories for smelting or for producing machinery or metal products.

It is therefore, not surprising that any machine tools available in the country are not of the fully automatic type. The machine tools that can be found are mainly of the manual type with some semi-automatic machines.

The workshops belong mainly to the Public Works Department, Ministry of Agriculture and Agrarian Reform, Ministry of Defence, Port Trust, B.P. Refinery, National Shipping Company Dockyards and several small private jobbing workshops. Most of these workshops are situated in the first Governorate with one or two

small workshops in the fifth Governorate.

The Public Works Workshops.

The Public Works garages and workshops looks after the maintenance of government vehicles, trucks and road construction equipment totalling over 1,000 in number.

The problems of maintenance are rather formidable. Firstly, the shortage of funds due to the economic crisis, forces the department to continue to use equipment well past its normal useful age. Secondly, the problem of non-availability of very skilled operators and mechanics, continues to keep the standard of operation and maintenance rather inadequate. Thirdly, the lack of materials means that practically all spare parts have to be imported, thus putting a continuous call on the governments scarce foreign exchange resources. Fourthly, the arduous climatic conditions, which include high temperatures, high humidity, high salinity and sand storms, shorten the life of equipment of all types and add to the problems of maintenance. In addition the terrain is very rough and the roads - or rather tracks - are very poor and put considerable strain on the vehicles and equipment which uses them and adds considerably to the need for maintenance.

The machine tools in these workshops are all of the manual type, are old and in many cases no longer sufficiently accurate and reliable. The largest lathe is an ordinary centre lathe 16" X 72" and is more than ten years old. There are also a few smaller lathes of which only one is functioning properly. There are also drilling machines, power saws, shapers, etc. but there are no capstan lathes, crankshaft grinders, gear cutting machines or planing machines or even a satisfactory milling machine.

The standard of machinists is rather low and most of the time they are engaged in the production of bushes and bolts or are cutting plates to size for welding purposes. The machine shop has no foundry attached to it. In

fact, very little casting is done in the country. However, there are casting facilities in some workshops, for instance, there is a workshop which has a capacity to handle castings up to three tons in size for the benefit of ships passing through Aden Harbour that are in need of repair.

It has become evident that the workshops should be reinforced and it should be possible to produce the simpler spare parts locally. Firstly the Ministry decided to extend the two main workshops considerably. These are the main workshops at Khormakear and Mukalla in the fifth Governorate.

The facilities in these workshops are very limited at the moment but it is expected that by the beginning of the year the workshops will have added to them many different machines. Khormakear central workshop will have added to it a universal milling machine, a radial drilling machine, an upright fine boring machine, a grinder, a heavy duty bar sawing machine, an open fronted hydraulic press and pedestal grinder. The Mukalla workshop is to have a universal tool grinding machine, a universal milling machine, a small end mill arbor, a heavy duty bar sawing machine, an open fronted hydraulic press, an upright fine boring machine, etc. with the necessary accessories. The above mentioned list is in fact modest yet signifies a considerable reinforcement to the workshops.

These extensions of the above mentioned workshops are merely to enable them to cope with their present duties more adequately. At the same time, the Ministry managed to obtain help from U.N.I.D.O. in the form of two experts (each for about six months) to improve the organization of workshops and the standard of maintenance carried out by the workshops. These two men have just arrived in Aden.

The government also arranged to obtain from the United Nations two mobile workshops and has also contracted, through bi-lateral agreements, for more mobile workshops.

However, the question of production of the simpler spare parts locally still persists and the government has approached the International Bank with

request for finacing a project which includes expansion of the workshops so as to make them able to produce the simpler spare parts. The I.B.R.D. noticed that nearly half of the P.W.D. road equipment was out of order due to lack of spare parts and also noticed that the workshops' machinery and tools were inadequate. Also it noticed that all the equipment and machinery needing spare parts were of Western origin and as there was no appropriate bilateral aid it decided to include in the project it was financing the procurement of spare parts and workshop equipment, etc. It evaluated the existing useable tools and equipment at the P.W.D. at above £100,000 and found that this equipment was not capable of keeping existing useable road equipment in good working order. It decided to allocate £300,000 for the procurement of spares and workshop equipment capable of producing some of the simpler parts normally imported. Tools, stores equipment and mobile workshop equipment is to include centre lathes, milling machines, gear shapers, boring machines, crankshaft grinding machines, sawing machines, etc. The I.B.R.D. included in its project the training of one machine shop supervisor.

The arrival of all the machines mentioned should considerably alleviate the problems faced at the moment. However, it will not altogether solve them, the department will still be lacking experienced machinists and mechanics for the operation and maintenance of the machines.

Technical Assistance.

As U.N.I.D.O. has already provided technical experts on workshop organisation, certain of the most obvious and most urgent problems are being dealt with. Consideration should be given to the establishment and staffing of the training centre for craftsmen and technicians. Advice and assistance should be given in the establishment of a suitable testing laboratory to meet the requirements of the country. Advice and assistance should be given on the establishment and operation of preventative maintenance and machine tool rebuilding programmes.

ROMANIA

The continuous progress of the national economy and respectively of the machine building industry, lead on the first place to the development of the machine-tool building industry.

The production level in 1970 as to the 1965 was two times greater, material and phisic.

As to the sort the performances in 1970 are 70 % greater than those in 1965.

The most important machine-tool works have contributed to the achievement of the manufacturing and set programm, as for instance :

- The machine-tool and aggregate factory-Bucharest, producing heavy machine tools : vertical turning and boring mills, boring and milling machines longitudinal/transv. plane-milling machines external and universal cylindrical grinding machines, centrelless grinding machines, aggregates and standard elements.

- Strunguri Arad works, manufacturing centre lathes, turret lathes and vertical turret lathes.

- Infrățirea - Oradea works, manufacturing vertical drilling machines, internal threading machines, radial drilling machines, planing machines, tool-shop milling machines pneumatic hammers.

- Mechanical Works - Sibiu, manufacturing, circular saws and power hacksaws, power-presses, hydraulic presses up to 160 tf, metal sheet working machines.

- Mechanical Works-Suceava, manufacturing drilling machines, grinders, beading and rolling machines, steel

forming machines and pipe bending machines.

- Mechanical Works-Cugir, producing milling machines, gear cutting machines, internal grinding machines, plane grinding machines, mechanical broches, electromagnetic chuck-plates.

- Mechanical Works - Plopeni producing special machines for the manufacture of bearing balls, tool grinding machines, horizontal and vertical broaching machines, some hydraulic elements for machine-tools.

- 6 Martie Works - Zărneşti producing machine-tools accessories (universals with 3 and 4 blades, chucks, dividing heads etc).

The main types of machines which have been introduced in lot production are :

- vertical boring and turning mills Ø 125o ; Ø 16oo and Ø 32oo mm ;
- horizontal boring and milling machines Ø 1oo ; Ø 125, Ø 15o ;
- internal grinding machines Ø 8o
- portal longitudinal milling machines (table width 66o - 1ooo - 16oo) ;
- centreless grinding machines Ø 2oo mm ;
- external and universal grinding machines Ø 1oo and 32o mm.
- radial grinding machines Ø 4o - 7o ;
- aggregates ;
- standard units ;
- centre lathes Ø 25o - 8oo mm
- turret lathes Ø 25 - 4o mm ;

- vertical drilling machines Ø 13-4o mm ;
- threading machines M8-16 mm.
- tool-shop universal milling machines 2oo-25o mm;
- planing machines with inserted blade 45o ÷ 8oo mm.
- pneumatic hammers 63-16o tf.
- inclinable bed automatic presses 64 ÷ 4o tf.
- power-haw sacks 25o mm.
- circular saws 71o ;

On base of licence have been assimilated

- boring and milling machines from Cerutti Italy
- vertical boring and turning mills from Morando - Italy
- longitudinal portal milling machines from Köllman-West Germany
- internal grinding machines from Nova-Italy
- ball griding and filling machines from Giustina - Italy.
- universal and external grinding machines from Fortuna - West Germany.

In thes period has taken place not only a quantitative growth due to the production diversification and the assimilation of new types of machine-tools but also a qualitative growth concerning the accuracy and the automatisation rate.

Consequently the new machines are to be equipped with a larger number of normal and special accessories enlarging their usability area.

Within the permanent development of machine-tool building, a special attention must be paid to the research and development activity, in which sense has been set up

the Machine-Tool and Aggregate Research and Design Institute Bucharest.

The main targets of the Institute are the achievement of new types of machine-tools and the permanent improvement of the previous assimilated machine-tools, to a corresponding technical level.

The institute carries on an activity in close connection with the design offices of the machine building works, as well as with other specialized institutes.

The first aim for the long-term period is to meet as much as possible the internal demands, by the continuous development of the industry in the Five-Year Plan 1971 - 1975.

The growth of the machine - tool building output should be 3.1 times in 1975 as to the 1970. On the first place are expected growths on :

	growths 1975/1970
- Turret and automatic lathes	5,7
- Production and tool-shop milling machines	2,6
- Grinding and superfinishing machines	2,8
- Heavy machine-tools	2,4

The following important problems are in view :

- The extending of the specialisation and outlining of the works in order to meet the industry demand ;

- The widening of variant number and single-purpose machines, derived from the same basic family.

- The delivery of some machine-tools provided with special accessories, control equipment - programm control included in function of the customer demand.

In order to bring about the established rate of the production growth, the development of the existent units and the building of new ones are provided, such as :

- The new factory of machine-tools - Bacău, for portal milling machines and horizontal boring and milling machines.

- The new lathe factory - Tîrgoviște for normal lathes over 600 mm, turret lathes and automatic.

- The new foundry for machine-tool parts-Alba Iulia.

- The new factory for machine-tool accessories.

It is provided the assimilation of autolathes, grinding machines, tool-shop and production milling machines, facing lathes, cutting machines and the introduction of program numerical control machines.

The assimilation numerical control machines develops on base of an assimilating priority program, as well the redesigning of the existent products which have to be equiped with program control system.

Up to the present the problems referred mainly to the design of the mechanical part of the machines, and the control and dimension display equipements.

It is provided also the introduction of the numerical linear, contour and positioning program control

for some types of machines such as : centre lathes, turret lathes, vertical turning and boring lathes, milling machines, drilling machines.

Several producto which present features are no more competitive with those of similar products on the world market, should be modernized and redisigned.

On the same time the growth of the availability of the products for the export demands should be in view.

The Romanian machine building industry production represents about 130 types of machine-tools, from which almost half for export.

From a valoric point of view the Romanian machine-tool present export is about 20 % from the whole value of the machine-tool production, following to reach 32 - 35 % in the next years. The machine - tool manufactured in Romania are delivered in more than 40 countries all over the world.

The development of the machine - tool production, in units and values, in different periods may be presented as follows :

	1965/1960	1970/1965	1975/1970
values	200	245	338
units	160	162	163

It results that the value of the machine tool production, grows much faster than the production volume calculated in units, showing the constant effort

to build high quality machine tools, better equipped and consequently with a higher price.

Romania is interested in the extending of the international cooperation activities, having in view the mutual advantages, for both parts, for the following types of machines :

- turret latthes
- facing lathes
- multe-spindle auto-lathes
- production milling machines
- jig boring machines
- installation and full equipment for machine - tool programm control.

In the research and design field Romania is also interested in the cooperation with other countries for the a chievement of a commun established methodology regarding research problems such as : mutual change of results and their interpretation, especially for the following categories of measurements.

- dynamic stability and vibrations
- static rigidity
- thermal deformation
- noise
- positioning accuracy (for numerical control machine - tools);
- kinematic accuracy (for gear cutting machines)etc.

There are also possibilities to realise an effective change of detailed information in problems regarding

the research and design of numerical control machines, machining centres, machine systems and completion of assemblies for these machines, as well as of the numerical control systems itselves. This change may constitute an important help for countries with less developed industries.

Any documentation and technical information from and to the countries interested in the problems of new building solutions for machine tools, including bearing production, hydrostatic guides and screws, ball screws, roller slides, hydraulic motor feed mechanism, tool prepositioning devices etc.
will be of a great support in the industrial activity.

Having in view be the continous development of the Romanian machine building industry, the future production of machine-tools will take a higher rate, which will bring the socialist Republic of Romania between the world industrial developed countries.

SAUDI ARABIA.

Metal Working Industry.

Reliable statistics for industrial activity in Saudi Arabia are not available. There is no legislation compelling industrial establishments either to inform the government of their existence or to submit production and other industrial data to the authorities. Unless foreign capital is involved or the industrial unit wants exemption from customs duties in respect of import of industrial plant, equipment and raw materials, no industrial licence is necessary for setting up any industrial enterprise. Hence the meagre statistics which are available have to be supplemented by assumption based on personal experience.

In the year 1967, the Central Department Of Statistics conducted a survey of all industrial establishments in 25 cities. This survey revealed a total of 9,173 manufacturing establishments and of these 4% are in the metal working industry. A breakdown of the metal working industry figures, shows that there were 3,308 establishments employing less than 5 people, 216 employing between 5 and 9 people and 98 establishments with 10 or more employees. Total employment in these metal working establishments with 5 or more employees amounts to 3,926.

The metal working industries in Saudi Arabia started primarily as service industries and there is at present quite a large number of small repair shops catering basically to servicing and maintenance of automobiles, bicycles and motor scooters. On the manufacturing side the metal working industries are primarily manufacturing:-

(a) Steel furniture, both sheet metal and tubular type.

(b) Aluminium doors and windows, out of imported extruded sections.

(c) Venetian blinds and window awnings, from imported aluminium and steel strips.

(d) Aluminium utensils, spun and pressed (but not cast).

(e) Rolling shutters.

(f) Wrought iron grills for railings and fencing.

(g) Desert Coolers.

(h) Non-ferrous and ferrous castings, to a limited extent.

In some of the industries the quality of products is good. Designs are mostly copies of current European products. Shop floor management, skilled workers and to a certain extent non-skilled workers are mostly expatriates. Hence comparatively high wages have to be paid to induce them to leave their home countries and come to work in Saudi Arabia. There is a tendency for employing more labour saving devices, and the degree of mechanisation in almost all industrial units is fairly high compared to the position in other developing countries. Automation however, has not yet come in the metal working industries of Saudi Arabia. The machinery are still general purpose ones and automatics are non-existent. There is virtually no local supply of tools, jigs and fixtures. Heat treatment facilities do not exist in the country. Mechanical, metallurgical and metallographic testing facilities are not available. The position is the same regarding design facilities.

Almost all metal working industries suffer from the problems of maintenance and repair. There are no commercially run maintenance and repair workshops to look after the machine tools other than industrial machinery.

Protection of Local Industries.

There is virtually no restriction regards imports in the country. Hence local industries have to compete with industrial products of advanced countries, which are sometimes dumped at prices which may not necessarily be based on the cost of production. With no price protection, industries are hard-put to

compete with imported products. The concession which industries get is to have their industrial plant and equipment and raw materials imported duty-free. However, the customs tariffs on finished products are not high therefore, the margin which the manufacturers have by obtaining raw materials duty-free is often not sufficient for them to compete with imported products. It is therefore, felt that for some time metal working industries will develop along those lines where, due to sheer bulk, for example the outside manufacturers cannot compete on account of excess freight. Thus it seems development for the near future will be restricted to service type industries like maintenance and repair and the production of bulky items such as steel furniture, refrigerators, desert coolers, bulk containers, etc.

Development of the Metal Working Industries During The Next Five Years.

The metal working industries which, it is felt, can expand profitably during the next five years, together with certain new industries for which there is a prospect of development are enumerated in Appendix. Against each of these sections of industry is shown the current number of companies and employment in the industry, the expected future capacity together with the additional employment and machine tool requirements to cover the expansion.

Education and Training.

There is an acute shortage of skilled manpower and entrepreneurship. Most of the technicians and skilled workers are expatriates and unless local skill can develop quickly, labour costs will remain high.

Training centres should be established in certain of the industrial centres, where skilled workers and technicians can be trained. It may be necessary to review the quality of secondary education to ensure that there are sufficient young men coming forward who are capable of assimilating the instruction at the training centres.

Technical Assistance.

U.N.I.D.O should provide an expert to review the engineering industry of the country as a whole and advise whether the machine tools are being adequately utilized and maintained. He should also advise whether training should be given in the establishment of preventative maintenance programmes and machine tool rebuilding.

Assistance with establishment of the proposed training centres should be provided by one of the developed countries or by United Nations. U.N.I.D.O should assist with the establishment of a machine tool selection and advisory service. Scholarships should be given to allow selected personnel to study in developed countries, business and industrial management.

5 Year Industrial Expansion Programme.

Industry	Present No. of Companies	Employment	Future Capacity	Additional manpower	Additional M.T. & Equipment
Metal Doors and windows	4	56	400 tons	125	31
Steel Furniture	14	405	800 tons	240	55
Aluminium Utensils	4	123	500 tons	50	26
Foundry C.I.	N/A	N/A	6000 tons	110	2
Trunks, cabin and baskets	8	148	150 tons	130	37
Repair and Maint. shops	29	470	-	125	100
Aluminium Extrusion	Nil	Nil	1,500 tons	90	5
Gas stoves	Nil	Nil	200 tons	35	6
Assembled Vans.	N/A	N/A	500 tons	35	18
Wire Netting	Nil	Nil	1,500 tons	25	10
Air conditioners & Refrigerators	Nil	Nil	6,000 tons	75	30
Electric Fans	Nil	Nil	10,000 units	12	9
Electric cable	Nil	Nil	120 tons	10	7
Regulex	Nil	Nil	12,000 cycles	25	31

SYRIAN ARAB REPUBLIC.

Status of Machine Tools.

Statistics relating to the engineering industry are given in appendix 'A'. At the present time the most important machine tool using works are the Railway - 60 machine tools; Oil Field + Fertilizer (20 machine tools each) Maintenance Workshops.

A large factory has been built at Aleppo which initially will be used for assembly of French built Someca tractors and it is ultimately intended that this plant should manufacture certain of the components used in the tractor assembly and also produce ironmongery for the building industry.

An electric motor factory is to be established at Lattakia with a capacity of 25,000 motors per annum ranging from ¼ h.p. to 7½ h.p. a Bulgarian firm are the advisors on this project and the building is now complete. Adjacent to this factory, a foundry and forge are to be located, the capacity of the foundry to be 25-30,000 tons of ferrous and non-ferrous castings and the forge 8-10,000 tons of forgings. The Metal Construction Company (Katerailia) located North of Damascus manufactures a wide range of stationary and mobile storage tanks.

The textile industry, are to establish at Damascus and Aleppo, a factory for the manufacture of spare parts required by the textile machines.

Establishment of Machine Tool Industry.

The government are considering the establishment of a small machine tool industry to produce a range of machines at the production levels shown in the appendix 'B' phase one. It was proposed to proceed to phase two, after the first phase had been successfully completed. Due to the low level of demand very careful consideration should be given as to whether this would be an economical proposition at the present time although the association

with a suitable company of a foreign country may enable manufacture of certain simple machines to commence on an economic basis. There is also the possibility that the Craft Training Centre at Damascus might manufacture the drilling machines in order to provide the students with some useful production work to undertake. It has been suggested that U.N.I.D.O. could give advice on the methods of obtaining the necessary equipment and technical assistance, on the basis of a foreign company providing a manufacturing licence and with the possibility of also providing part of the finance.

If it is decided to go ahead with the machine tool building establishment, it is important that this should be a self contained unit and should not be included with any other machinery manufacturing programme where the standards may be of drastically different order.

Machine Tool Rebuilding.

Most of the machine tools in use are of considerable antiquity and being located in extremely small workshops, the only maintenance these receive is routine lubrication. Repairs are carried out when the machine actually breaks down and these are of a minimal nature in order to get the machine into operation again. The effectiveness of many of the machine tools used in the country could be greatly increased if these were rebuilt so that the original alignments are regained and slides and bearings properly refitted so that faster metal removal rates can be achieved.

It is suggested that U.N.I.D.O. should give the technical advice on the establishment of a centre and provide the supervising experts and necessary equipment. The Syrian Government on their part would provide the suitable buildings, manpower and other necessities.

Tool Maintenance.

Tool grinding is usually carried out entirely by hand and there is little appreciation of the importance of geometry. The most effective means of

improving this situation, although of a long term nature, will be to ensure that this subject is given full attention both at the Craft Training Centres and at the In-Plant Training Centre for graduate engineers, in order that an awareness of the importance of correct tool servicing should be created both at the engineer level as well as among technicians and craftsmen.

Education and Training

Technical education is extremely limited but the demand for technicians in view of the type of small scale industry operating in the country is also severely restricted.

The need for improving the training of engineers has already been appreciated and it is proposed to establish an in-plant training centre for engineers to assist newly graduated engineers in obtaining sound shop practical experience and also for the purpose of up-grading engineers already working in the industry in modern industrial methods and practices.

Craft training centres have been established at Damascus and Aleppo and these each have a capacity of 300 students when operated on a single shift basis. However, due to severe shortage of training personnel, the centre at Damascus is only operating at half this capacity. Most of the trainees already have shop practice but attend the centre to improve their standard. They undergo a three month probationary period and at the end of this, if considered satisfactory are given a further six months training. They are only taught a single skill and approximately 80% of their time is in the workshops and 20% on classrooms. There is a well equipped machine shop principally with engine lathes, electrical workshops and a small pattern shop and foundry.

Research

An Industrial Testing and Research Centre is being established in Damascus with United Nations assistance. The expert guiding the setting up

of the centre is Mr. Barfety from France, who has included the establishment of standards in the work of the Centre.

Machine Tool Maintenance.

In order that the importance of adequate and preferably preventative machine tool maintenance should become accepted in the larger engineering firms it is recommended that this subject should also be included in the curriculum for the In-Plant Training Centre.

Acceptance Standards.

The recently established Industrial Testing & Research Centre should become the focal point for the establishment of acceptance standards for machine tools. These should be established in line with international practice but adapted where appropriate to local requirements.

Numerically Controlled Machine Tools.

With reference to the availability of manpower and the man-hour costs in Syria, there is no necessity and it is not economical to use numerically controlled machine tools at present. However, after the next four years it will be necessary to use N.C. machines and automatic machines in all fields because the Alfurat Dam Project will be finished and agriculture and other industries will attract and contain the workmen in Syria and it will therefore, be necessary and economic to use automation.

Technical Assistance.

U.N.I.D.O. should assist the Syrian Government with the setting-up of a machine tool rebuilding plant. The United Nations should provide an expert on tool maintenance and tool utilization. U.N.I.D.O. should advise the Syrian Government regarding the possibility of finding a suitable partner for the economic manufacture of machine tools within Syria. U.N.I.D.O. should advise on the establishment of suitable machine tool maintenance educational programmes and the training centres.

Appendix 'A'
Syria.

Statistics 1968/9

Industry	Numbers Employed in each.
Food and tobacco	32,000
Textiles, Leather and Clothing	42,000
Metal Working and Equipment Manufacture	8,000
Chemical, excluding Petroleum	5,000
Transport Workers	35,000
Manufacture and repair of Electrical Machinery	1,900
Manufacture and repair of Transport Equipment	4,800

[illegible]

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

[illegible] - from survey of Ministry of Petroleum

[illegible] firms employing 10-99 workers with 10-99 Machine Tools.

[illegible] firms employing 1-9 workers. - Only 10% of these firms use machine tools.

Appendix 'B'
Syria.

Proposed Machine Tool Manufacture. - Production programme per annum.

Phase 1.

180	Bench drilling machines	Max. diameter 10-13 mm
120	Pillar drilling machines	Max. diameter 20-25 mm
80	Hacksaw machines	Hacksaw blade 630 mm
100	Sliding, surfacing and screw-cutting lathe	Length 800 and 2000 mm Swing diameter 355 mm
80	Horizontal milling machine	Milling table 355 X 1250 mm
120	2 wheel grinding machine	Grindings diameter 250 and 350 mm
60	Bandsaw for wood	Diameter of band 1800 mm

Phase 2.

50	Shaper	Stroke length 400 or 630 mm
50	Hydraulic surface grinding machines with horizontal spindle	Table working surface 250 X 600 mm
60	Universal woodworking machines for drilling and milling	Height of centres 150 mm
40	Universal grinding machines-hydraulic	Nominal diameter 200 mm grinding length 400 or 600 mm
[illegible]	Sharpening machines for tools and cutters	Nominal diameter 200 mm grinding length 400 mm
[illegible]	[illegible]	
[illegible]	[illegible] milling machines.	

TURKEY

Machinery Manufacturing Industry.

The machinery industry is a sector that necessitates technology and a technology as such requires experienced and qualified labour force. Scarcity of such labour causes delay in the realisation of investments as well as limiting the varieties in production.

Ratio of utilisation of capacity in this sector is generally low. With the exception of a few large establishments, production planning to increase output in a technical sense, is not realised. This is mainly due to the fact that the production capacity has been divided into small units. Because of the limited financial resources that are available for these small units, project design and quality control etc., could not be used to the greatest benefit. For this reason, production and quality generally remains low and well below the required standards.

The cost of raw materials provided for the producers, either from domestic sources or through importation, is high. However, the price can be lower in the case of producers who import their own materials.

In this sector, approximately 65 per cent of the demand is met through imports. Although the increase in domestic production substitutes a large scale of imports, no significant change of import ratio in overall demand is yet noticeable.

PRODUCTION OF MACHINE TOOLS.

In Turkey, machine tools are manufactured under various licences. The following table indicates the target for machine tools production

Production	1970	1971	1972	1977	1982
Milling Machines	15.0	23.0	30.0	46.0	56.0
Drilling Machines	16.0	21.0	30.0	45.0	50.0
Planer	4.0	7.0	9.0	19.0	32.5
Grinding Machines	4.5	7.5	10.0	23.0	34.0
Lathes	20.0	27.5	35.0	57.5	75.0
Total	59.5	86.0	114.0	190.5	247.5

Million TL
"y"

There are four companies specializing in this field, three of which manufacture lathes only. Production figures are as follows:

Universal lathes produced between	1965	and	1970	1,000
Upright and portable drills	"	"	"	740
Milling machines	"	"	"	110
Planers	"	"	"	70

Import of Machine Tools.

As manufacturing capacity of centre lathes coincided with demand, importation of all sizes of centre lathes was prohibited in January 1970. This decision was taken in order to protect the domestic production.

At the present time only automatic lathes and semi-automatic copying lathes maybe imported under the investment quotas on condition that the permission is secured. However, for those who obtain an import licence, with the exception for the investment goods, customs protection is not applied. Generally duty is levied at a rate of between 50% to 70% on the cost of the lathes imported.

Since the import prohibition, lathes manufacturers have made attempts to operate their factories to full capacity and to further improve the conditions in their plant. The information obtained from the annual bulletin of the Statistical Institute is given in the table below:

Type of Machine Tools	1960	1965	1966	1970
Milling Machines	90	144	178	821
Drilling Machines	975	2803	4756	1865
Planers	33	157	398	397
Grinding Machines	930	1774	2790	1945
Lathes	290	960	1654	1161
Total	2818	5838	9750	4917

Demand and Supply Of Machine Tools.

In accordance with Turkey's expansion projects, machine tools production targets for the next five years may be estimated as follows:

Years	Type of Machine Tools	Supply	Demand
1970	Lathes	380	600
1971	"	750	900
1972	"	1100	1100
1973	"	1200	1300
1974	"	1400	1400
1975	"	1500	1500
1970	Milling Machines	60	200
1971	" "	120	240
1972	" "	180	280
1973	" "	240	320
1974	" "	380	400
1975	" "	400	450
1970	Drilling Machines	350	1800
1971	" "	650	2000
1972	" "	750	2200
1973	" "	850	2300
1974	" "	1200	2400
1975	" "	1800	2500
1970	Planers	30	250
1971	"	60	280
1972	"	120	310
1973	"	180	330
1974	"	350	350
1975	"	400	400

Details of estimated demand are given in appendix 'A'

As can be seen from examination of the above table, two or three large manufacturing firms have enough capacity to meet Turkey's need in a short time. Since these plants, which are situated in or around Ankara and Istanbul are equipped with universal machine types, they can be directed to the production of other machine tools at short notice.

According to estimates, Turkey's annual need of machine tools (lathes only) will be around 1,500 and provided that they can be operated to 70% capacity, existing installations can meet this demand. Considering the rate of industrial development and market demand, excess capacity can be used to manufacture special lathes and other machine tools. With a few exceptional cases such as technical schools and the maintenance units in some state industries, all the machine tools are purchased and used by the production industry. Since the domestic production is still low, the import statistics may be the only source to determine the demand but the availability of foreign currency and the period that elapses between the time of order and delivery, varies from time to time but generally is approximately two years. However, it is estimated that the demand for 1980 may reach to one million Turkish Lira. The figures indicating the demand for lathes, milling machines, drills and planers until the year of 1975 reflects only a personal view.

In addition to the machine tools which are currently being produced, it is anticipated that during the next five years, the following types will be introduced: Revolving turret lathes, radial drilling machines, multi-spindle drilling machines, knee and bed type milling machines, process and patterns copying machines. The longer term future, machines are likely to be introduced such as, surface grinding machines, automatic machines, special-purpose machine tools and numerically controlled machines.

Obstacles Encountered In Large Scale Machine Tool Production.

The principle reasons can be defined as follows, deficiency of technical documentation, failing to apply the techniques of production and inspection and failure to make use of ancillary industries. The shortage of qualified workers leads to single-shift working and labour turnover results in loss of workers, just when they have acquired the necessary skills. Difficulties are experienced in purchasing suitable raw materials and semi-finished materials

at the right time, especially when these materials have to be imported. The availability of jigs and fixtures to meet production programmes causes serious inconvenience and there is a shortage of indigenous production of these items.

Production planning and production control play an increasingly important roll as the scale of operation increases but the number of engineers experienced in operating sophisticated systems in this area are extremely limited. Particular difficulties are experienced with engineers who having become acquainted with the requirement, move on to other better paid jobs. Thus, manufacturing procedures, etc., cannot be improved and the modifications which were to be completed in the short term, cannot be carried out.

Industrial Investments

Generally, in the development of an industrial sector, various factors like design and adaption, availability of raw materials and semi-manufactured goods, production ways and means, state of labour, management and industrial organization play an important part . Private engineering firms, capable of handling the designs and adaption of the machinery and the machine tools have been established in Turkey only recently. Necessary steps have been taken for the promotion and encouragement of such firms. Due to the limited availability of personnel, design offices in the state organizations are found to be unsatisfactory. In the absence of industrial engineering and insufficient technical know-how, some small scale private establishments incline to manufacture machinery by copying and as a result they produce outmoded and low quality items. For the production industry, major raw materials such as castings, iron and steel, copper, aluminium and semi-finished products are practically unobtainable. In order to meet the demand for iron and steel, after Karabük and Ereğli, establishment of the third iron and steel plant in Iskenderun is progressing. Attempts have been made to increase the production of quality steel manufacturing factories.

Instead of using automatic and special machines for manufacturing

quality and low priced products in general, universal types of machines are utilized. With the exception of some special production methods, there exists satisfactory know-how but necessary organization for mass-production has not been set up. Generally, consideration is not given to specialization, instead the manufacturers prefer the complete unit type of production. Consequently, this leads to uneconomic utilization of special and automatic machinery. Furthermore, not employing a sufficient number of engineers, production methods cannot be improved, prototype is not realized and therefore, the necessary changes that are required from time to time, cannot be carried out. Outside the state enterprises and some large private organizations, quality control is either not done at all, or carried out to a limited extent.

Although there is no shortage of labour generally, qualified labour is limited. Industrial engineers, technicians and foremen are shorter still. People equipped with knowledge on operational management are not found easily. For this reason, both short and long production plans and control of products, distribution of work and follow-ups are still in undeveloped stages. It is generally accepted that there is an excess capacity of machinery and machine tools. If however, co-ordination among organizations or even between the units of the same enterprise is established and investments for extension and modern management methods are implemented, it will be possible to utilize the excess capacity.

Export Incentives and the Regional Trade Agreement

Up to the present time a regional trade agreement between Turkey, Iran and Pakistan have made no effect on the machine tool trade, although joint machine tool projects have been prepared it is not yet operative. Exports into other countries have been restricted under licensing agreements and due to heavy home demand, machine tools have not yet been available for general export.

Education.

Primary education is for a period of five years, so that the majority of boys complete their education by the time they are eleven or twelve when they commence work which is usually for about 60 hours per week. Many of these boys go into the private sector industry as apprentices but the standard of craft training in these industries is reputedly extremely low. Such training however, is a considerable advance on the alternatives which exist for boys remaining in the rural areas where their tasks may be no more exacting than tending the sheep in the mountains.

A select few continue to secondary education which covers a further five year period. The majority of these are anxious to go on to University but there are insufficient places for all those wishing to do so, resulting in a long waiting list for vacancies. The Government consider that there is a serious shortage both of graduates and even more so, of technicians in industry and have prepared a new secondary education plan in order to remedy the large gap in middle education. The provision of secondary education in technical schools will be organised under the new plan and these boys will be expected to go direct into industry on completion of their schooling, in order to meet the requirements for more technicians in industry. The working hours in which boys are permitted to work are also to be restricted in the future. Some concern has been felt about the introduction of virgin graduates direct into industry from the Universities. A pilot scheme is being organised at M.K.E. factories under Government auspices with the assistance of U.N.I.D.O. whereby the graduate will obtain experience in a wide range of production disciplines within the various factories. M.K.E. are in a unique position to provide this facility in view of their parameters of manufacture ranging from steel making through batch and mass-production technologies. The number of graduate engineers in the machine tool industry is extremely small and reputedly in the private sector there are only a total of five. These numbers would clearly have to be raised if the industry is to continue

expanding even if it does not undertake design on its own account but continues to buy designs from abroad. It is imperative that the best modern technology be used in the production methods of manufacture and this is only likely to be introduced where the responsibility rests on a graduate engineer.

It would be extemely beneficial if some of the young graduate engineers, who have already entered the machine tool industry and gained some experience of the industry's actual requirements, could be given the opportunity of a fellowship to visit members of the machine tool industry in the developed countries.

Research and Development.

It is noted that the Government and the state owned industry are of the opinion that at this time it is preferable to undertake manufacture of machine tools to the design of a foreign manufacturer under a licence agreement. This agreement certainly offers considerable advantages during the initial establishment of a machine tool industry, however, there seems little reason why some machine tool design, particularly for simple machines, like the tool and cutter grinder or the surface grinder, should not be undertaken locally. It is understood that the Government are establishing a research organisation which could perhaps form the nucleus for the formation of a machine tool design team, together with the necessary test and proving facilities. Alternatively, the private industry machine tool companies might consider setting up a communal design office which would look to the Government research department to undertake specific research projects on their behalf or other test programmes which may be required.

The establishment of the design office and research work is another field where U.N.I.D.O. may be able to give valuable technical assistance.

The State Planning Organisation expressed the hope that the Seminar would give advice as to whether the organisation of design for machine tools should be located at the individual factory or central office. Also which machines

should be designed first and the reasons for this recommendation, together with the views of the experts on the types of machines which will be built in future to meet the rapidly changing needs of the highly industrialised countries.

Market Research.

The main effort of machine tool manufacture in Turkey has been directed towards building engine lathes. This policy and the advantage that the current needs of the engineering industry for these types of machine could be fully met from local production and at the same time the machine tool manufacturing companies were able to gain experience in manufacturing machines which were relatively uncomplicated but required a number of important machine tool manufacturing techniques to be developed. These techniques included the machining of the bearing ways and the methods of achieving machinealignments, the fitting of precision bearings into the bearing housings so that the bearings are not distorted, thereby reducing accuracy and causing premature failure. The manufacture of long precision screws and the production of gears and assembly of gear boxes.

As the engineering industry of the country develops it will be necessary to increase the range of machines which are manufactured, particularly as it is the Governments intention to orient small scale industry towards a production system to complement and supply large scale industry and to enable it to benefit from large scale industrial markets through sub-contracts. Production methods and technologies implemented in the large scale industry should therefore, be closely followed by the smaller organisations. If co-operation is realised between the small and large scale industries manufacturing in the small scale industries will naturally increase along with the progress of the large scale industries.

If the national resources are not to be wasted through the manufacture of machines which are unlikely to be required at the present level in years

ahead, a painstaking and thorough review of the anticipated future requirements of the engineering industry should be undertaken as a matter of urgency. The review should, in particular, consider the following machines:-

Tool and cutter grinding machine.

Reciprocating table surface grinding machine.

External cylindrical grinding machine.

Medium sized knee type milling machine.
(to complement the smaller sizes already manufactured)

Bed type milling machine.

Turret lathes - 2 sizes.
(The smaller machine should probably be of the Ram type turret).

Numerically controlled drilling machine (2½ Axis).

Drill sharpening machine.

The problems associated with the introduction of the numerically controlled machine may appear formidable but the advantages to be gained will be commensurate with the effort involved. Due to the relatively small scale of production in British industry the numerically controlled drilling machine offers considerable advantages by allowing freedom of component design and the elimination of complicated and expensive drilling jigs, the cost of which can seldom be economically justified unless there is an adequate volume of production, although it may be technically impossible that they be used.

Market research in the engineering field and especially in machine tools is an unusually complex question and cannot be undertaken by the normal market research organisations. It is essential that the survey be undertaken by a unit with a complete understanding of the capabilities of the machine tools and the associated operations to be covered by the survey. In addition, a knowledge of the developments which are taking place throughout the industrialised world in the machining field are also extremely important as the decisions which are to be taken from the survey report will commit the

company to a manufacturing programme which cannot easily be changed or reversed and may often cover a programme for a period of ten years or even more.

In view of the fact that the State industries and the private industry are together supplying machines to be used throughout Turkish industry, it is most desirable that some liaison committee should be formed with representatives from every tool manufacturing company where free interchange of ideas can take place regarding the future requirements of the entire Turkish manufacturing industry. This kind of liaison exists in the trade associations of the developed countries. It is suggested that U.N.I.D.O. should supply an expert to assist with the establishment of a market research operation of this kind.

Tool Sharpening.

In the M.K.E. factory at Kirikkale there was a properly organised tool servicing section for the regrinding of drills, milling cutters, carbide turning tools, etc., this however, appears to be the exception as the report by the I.L.O. Tool and Die Expert discloses that in the factories that he visited, tool servicing was virtually non-existent. The importance of the subject both as regards the increased manufacturing time taken through the use of incorrectly ground or blunt cutters and in respect of the greatly increased tool costs due to increased wear and tear and premature failure of the tool itself does not appear to be fully appreciated. Short term remedial action could be taken through In-Plant Training schemes of the type undertaken by the I.L.O.

A long term and permanent solution however, is required as the magnitude of the problem will increase rapidly as industry continues to expand. The subject therefore, should be included in the curriculum of the technical colleges in order that the new generation of technicians should be fully conversant with the subject.

Fixtures and Die Making.

The State industries report an acute shortage of design and manufacturing

Capacity for both fixtures and dies. This conflicts with the report of the private industry sector where there are reputedly a number of companies engaged in this field. The former report is probably more correct as it was confirmed by the I.L.O. expert but there probably are a number of small companies operating in this field but only achieving output of low quality. One of the reasons given for the preference of taking a licence from an established manufacturer of machine tools in a foreign country was the availability of proved jig and fixture designs, this would appear to indicate not only a shortage of design capacity but lack of quality of local design. In a country which is rapidly developing its industrial capacity, it is essential that this field be adequately developed if product design is not to stagnate due to the inability of introducing new component designs on the shop floor to meet changing requirements. It is believed that there is considerable talent available among the younger nationals who have returned to their country after working for a period of a few years in Germany. As the jig, fixture and die manufacturing companies in most of the industrialised countries of the world are relatively small specialist firms, the problem should be capable of rapid solution if a suitable action could be guaranteed to bring together the existing talent and adequate capital to acquire the specialist modern machinery which is needed for the efficient production of this type of equipment, together with a small team of competent designers who during the early period would benefit from some expert technical assistance.

Preventative Maintenance and Rebuilding of Tools.

Unfortunately, even in many of the highly industrialised countries, preventative maintenance is a subject which frequently receives little more than lip service. However, the efficiency of industry can be enormously improved, even if it is only conducted on the most elementary scale. The waste of foreign exchange and of national resources not to say the funds of

the individual company will be considerable if this technology is not developed to keep pace with the industrial expansion. It is not sufficient to allocate the responsibility for the maintenance to a shop supervisor together with a few mechanics. Where this is done, the results are at best haphazard and may prove totally ineffective. Carefully planned routine maintenance based on properly maintained records is essential. In its simplest form this may consist of no more than ensuring that routine lubrication and oil changes & normal adjustments are carried out at the specified intervals of time. As experience grows, it will be desirable to include simple tests to ensure that the alignments and accuracy of the machine are maintained and where necessary to undertake the necessary corrections and adjustments. In its more sophisticated form detailed inspection of components and assemblies will be made and where necessary, components replaced. It may even be found desirable that after specified periods of hours or years of service, certain components should be replaced regardless of their condition as the failure of certain vital components may lead to the serious damage of the entire assembly or to the machine as a whole, resulting in expensive and time consuming major repairs. After a period of many years service the general accuracy and condition of the machine may have deteriorated to the point where it is no longer regarded as being adequate for continued production. In many instances there have been no fundamental design changes to the type of machine which would cause obsolescence so that the rebuilding of the old machine to its original standards would be fully justified and it would then be capable of the same productive capacity as a new machine of the same class. The cost of rebuilding is usually less that half the cost of a new machine and the majority of the major components will be salvaged even though some reworking of them may be required. It is an especially worthwhile operation where labour costs are low and it must furthermore be remembered that in many instances the rebuilt machine will have greater stability than the new machine due to the ageing

effect of the main castings. It is however, important that this type of work should be undertaken by a firm specialising in the subject and has a complete understanding of machine tool manufacture is necessary if the rebuilding is to be successful. Complaints are often made about rebuilt machines being unsatisfactory but these can usually be traced to a company undertaking the work with little concept of the real tasks in which they are engaged. These companies rate the external appearance of the machine above the need for maintaining the quality of the working parts and of the machine alignments. There do not appear to be any companies in Turkey specialising in this field, so that the establishment of one or two firms of this nature is most important, generally it is desirable that these companies should be located close to the industry which they are serving but this should not be regarded as a fundamental issue if there are other considerations which may make alternative locations desirable. Management, skilled labour and suitable factory facilities are the key to success.

<u>The Sub-Contracting Exchange (Taşeron)</u>

The establishment of this exchange at Istanbul could play an important part in the development of the machine tool industry and also of the jig, fixture and die industry of Turkey. In the industrialised nations, these industries frequently rely to a large extent on the facilities for specialist manufacture of neighbouring companies. It is often uneconomic for a company to maintain the special machinery needed to undertake every kind of operation but on the other hand, the parts may not be capable of being produced to the quality standards required unless the specialist equipment is utilised. The exchange could therefore play a most important part in establishing contact between companies requiring limited productive capacity of a highly specialised nature.

The Peoples Bank (Halk Bankasi) could play an important part in the successful establishment of the exchange as the majority of their clients

are small businesses who would stand to gain most from the successful operation of the Exchange. The Exchange could also play a useful part in the establishment of a rebuilding service as a small company undertaking this type of work in the early days will need to establish contacts with many suitable sub-contractors to manufacture the various parts which it may be impractical to obtain from the original manufacturers of the machine due to the inevitable delays associated with importation. The Exchange would also play a further part which may not have been originally envisaged in its constitution, namely by informing companies where a rebuilding service is available.

Introduction of Simple Numerically Controlled Machines

One of the major obstacles to introducing numerically controlled machines is the lack of trained personnel capable of performing the programming of N.C. machine tools either manually or with computer aid. The simple machines however, manually can be satisfactorily programmed manually. Numerically controlled machines are more expensive compared to conventional machine tools. In order to overcome these obstacles, it is necessary to fully acquaint prospective users with the advantages of these machines and perhaps to organise a centre where programmed tapes or punch-cards can be prepared. It is suggested that I.S.I.R.O. could assist in this field.

Foreign Technical Assistance.

Foreign technical assistance in respect to machine tools production in Turkey develops mainly on the basis of "licences" and there are a few firms that have entered into agreements with some foreign firms such as Pittler-Werke of Germany, Strojimport of Czechoslovakia, Technoimpex of Hungary and Elliot of England.

Apart from the technical aspects of the licence agreements, it is worth while to discuss their contribution to the economy of the country

and the benefits from them. It is a fact that there are domestic firms which develop and grow gradually in the course of time with their own means and technical ability and it is a reality that their production is as good as the machine tools manufactured under licence agreements. One of the most important of these is Ahmet Bey Machine Tools Factory (the annual capacity is 100 lathes) and the other is Türk Makina Imalât A.Ş. (The Turkish Machine Manufacturing Company).

U.N.I.D.O. Assistance.

As has been suggested elsewhere earlier in this report, U.N.I.D.O. could assist in the establishment of a market research operation. U.N.I.D.O. could also assist in the setting up of an establishment to undertake design research work in the machine tool industry in order to reduce dependence on foreign licences which must restrict future development of the Turkish machine tool industry. The United Nations could assist with the training of technicians and graduates in the practical applications of machine tool manufacture. The fixture and die making capacity apparently needs to be expanded and the quality of tool servicing further improved. Expert advice in these areas will undoubtedly be beneficial.

Preventative maintenance programme should be established in the bigger factories and with the increasing number of machine tools in operation of which the earlier ones must by now be seriously losing accuracy, a rehabbing centre should be established.

ANNEX

MECHANICAL ENGINEERING INDUSTRIES

Drilling machines. Type.	Number	Grinding machines. Type.	Number
Table type	600	Stationary	1,200
Single spindle with column	750	Cylindrical surface grinder	400
Multi spindle with column	550	Tool sharpener	600
Radial	400	Surface grinder	600
other types	1,400	other types	900

Turning lathes. Type.	Number	Milling machines. Type	Number
Centre lathes	800	Vertical	800
Turret lathes	550	Horizontal	145
Single spindle automatic lathes	850	Universal	90
Other type lathes	400	Other types	185

Shaping machines. Type.	Number
Horizontal	300
Vertical	150
Other types	100

YEMEN ARAB REPUBLIC

Main Of Industries.

Due to lack of studies on the availability of machine tools in Yemen Arab Republic this report merely presents a general idea of machinery used in the main industries and mechanical workshops that exist in the country.

The major industries which utilize machines are a textile factory now in operation which was built by the People's Republic Of China. This is located in Hom's. A biscuit and sweet factory, located in Taiz which is privately owned and Cement and tobacco factories, still under construction near Hodeidah. There is an Aluminium factory, also privately owned which is in Taiz and three refreshment factories, manufacturing Pepsi-Cola, Canada Dry and Shihs. These are located in Hodeidah. Besides these, there are small-scale factories for oil extraction and flour mills.

Various mechanical workshops have been established during the building of the network of roads connecting the major cities - viz: Hodeidah, Hom's and Taiz. These workshops contain practically all the necessary machinery for road construction, repair of vehicles and welding machines.

Besides the afore mentioned machines, there are around 200 garages for the repair of motor cars and trucks, various agricultural machines, owned by F.A.O. is running these projects and about 250 carpentry workshops equipped with various woodworking machines.

Due to lack of qualified personnel to carry out studies in various fields, it is very difficult to estimate the demand, production and import of machine tools into the Y.A.R. The government also lacks any specific policy relating to machine tools.

Technical assistance has been mainly in the road projects mentioned above and at the present time, technical assistance has been started by F.A.O. in the field of agriculture. Assistance in building Sana'a International Airport by West Germany is underway and a technical school which is being started by the People's Republic of China.

The National Currency Board has started statistical studies on the import of all machinery and tools.

Rebirth of Yemen to face the technological advancement of the 20th Century took place in the year 1962. It is since then that the import of machines greatly increased and people developed interest in small-scale workshops and other mechanical works. Many of the people using the available machines in the country at the present time are self-trained. Consequently, due to lack of qualified personnel and technical advice, the life-span of many of these machines is very short.

Yemen is an importing country and it would take a fairly long time before it could become self dependent for the production of even the smallest machine tool. The reason behind this fact is that Yemen lacks many factors:

(a) The capital to be invested to start such industries.

(b) Yemen cannot supply enough qualified and trained engineers. Here again, the country is still dependent on foreign aid.

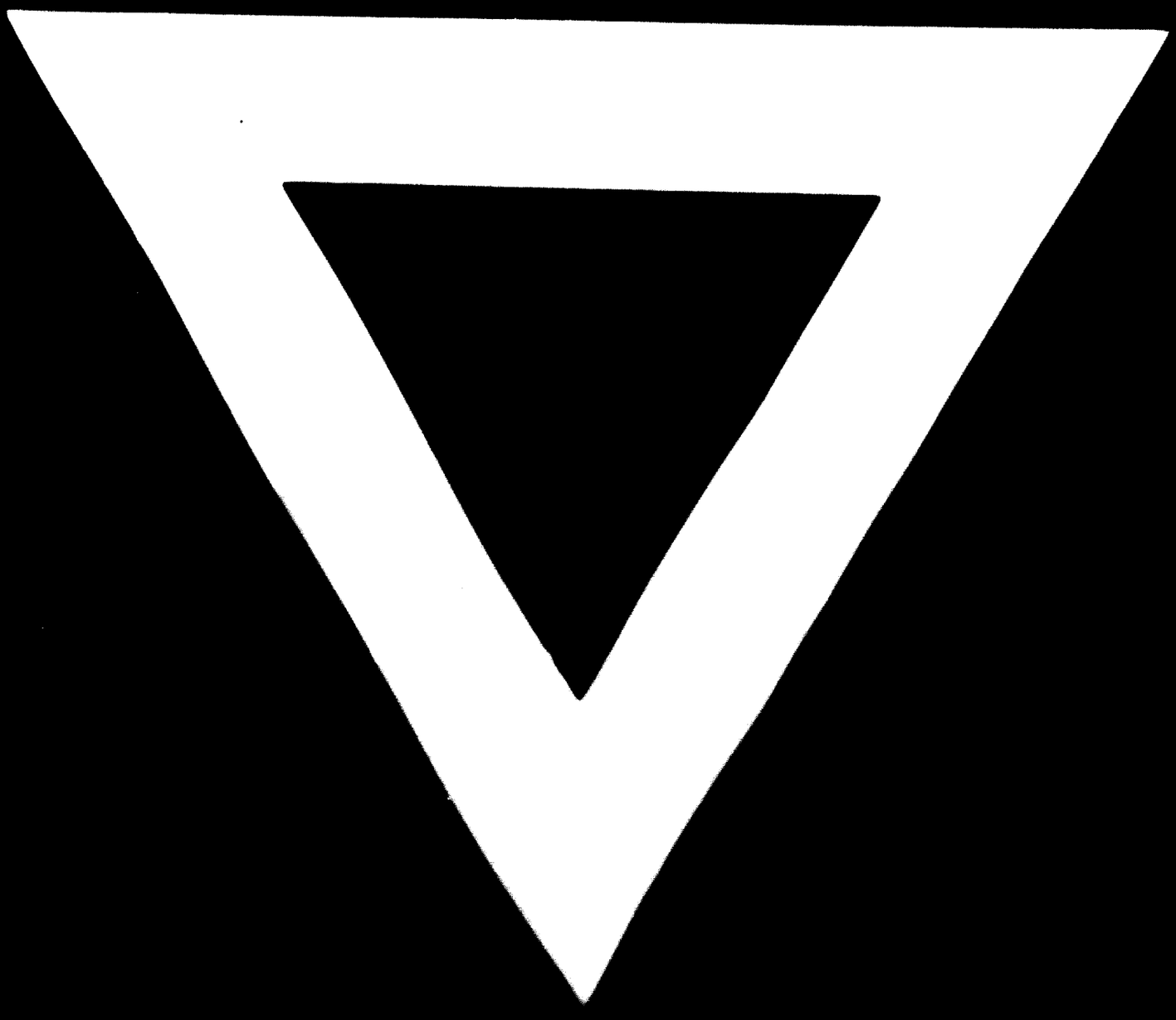
(c) Yemen is still a purely agricultural country. Since the agriculture of the country is of a traditional type with low production that does not meet the national consumption level, it would be unwise to shift to industrial development before the development of the agricultural sectors.

[redacted].

Urgent need for the technical training of workers, even to quite modest standards is clearly indicated. A survey should be undertaken to consider the most suitable method in which this can be undertaken.

A survey should be undertaken on the condition of machinery in use in the country and ways and means of ensuring that it is adequately maintained. As the F.A.O. are involved in an agricultural development programme, a survey should be undertaken in close co-operation with that body to prevent any duplication.

[redacted]



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