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**SIGNIFICANCE OF THE METALWORKING INDUSTRY
FOR THE DEVELOPMENT OF THE NATIONAL ECONOMY ✓**

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According to the statistics, the metalworking industries account for approximately 30 per cent of the world's industrial production, measured in terms of value added. Among the major branches of the industry, the metalworking has shown the greatest increase in production since 1938. The increase was more significant for the developing countries, but still there is a big gap between the share of the developed and developing countries in the total industrial production of the world.

The significance of metalworking industries for a country may be assessed by their share in the total industrial output, by the value added in the process of manufacture and the contribution to employment. In industrially developed countries the relative share of the metalworking production is within the range 30-40%, while in less industrialized countries it is below 5%.

As per the International Standard Industrial Classification /ISIC/, the metalworking industries produce the following goods:

- ISIC 35- manufacture of equipment /simple metal products or simple metal manufactures/.
- ISIC 36- manufacture of machinery, except electrical machinery.
- ISIC 37- manufacture of electrical machinery.
- ISIC 38- manufacture of transport equipment.
- ISIC 391- manufacture of professional, scientific, measuring and controlling instruments.

It is easy to see that practically everything around us is available due to the substantial help of the metalworking industries. The goods we use are either directly manufactured by machine tools, or by machinery produced by them. This applies for furniture, clothes, refrigerators, cars, medicines, toys, airplanes, even for food and water.

THE ROLE OF THE MACHINE TOOLS

Special place in the creation of a nation's welfare have the machine tools. Their importance is due to their basic functions in the national economy:

- a- to produce the means of production, i.e. the machines and devices which are required for production of various goods- for example machines for the textile industry, food processing machines, other types of machine tools etc.
- b- to produce consumer goods as household hardware, radios, refrigerators, stoves etc.

Generally speaking, nations with developed metalworking industries and particularly machine tool industry, enjoy high living standards. For example countries like USSR and USA have in operation over 3 millions machine tools, United Kingdom and Japan about 200,000, Canada 140,000.

If very significant, the number of the available machine tools is not the only criterion in defining the industrial power of an economy. Of considerable importance is also the percentage share of the various groups of machine tools in the machine

tool park. An analysis of the distribution gives the chance to make conspicuous the eventual distortions in comparison with an optimum park, i.e. the one that is close to the machine tool park of the most industrialized nations and is reflecting the latest development trends.

These trends can be broadly classified in the following ways:

- a- decreasing the share of universal and turret lathes by replacing them with high-productive, including numerically controlled lathes. Bringing the ratio milling machines to lathes within the range 1:2 to 1:3. /In many of the developing countries this ratio is between 1:4 and 1:8/.
- b- reducing the share of single drilling machines by replacing them with multi-spindle drilling machines and drilling machines with turret head.
- c- reducing the share of the shaping machines, planers and slotting machines. This tendency is most expressed for the shaping machines and least for the slotting machines.
- d- increasing the share of the grinding machines. Replacing the general purpose machines with special grinding machines, having high degree of automation.
- e- increasing the share of tool grinders. This tendency is not likely to last long because of the more extensive use of throw-away cutting inserts.
- f- modernization of the existing park of cut-off machines by replacing the back-saws by band-saws, abrasive cutting machines etc.
- g- broaden the use of special purpose machines, transfer lines, machining centres.
- h- introducing and extending the use of NC machines and systems of machines.

As an example, let us discuss the percentage shares of the main machine tool groups in the total machine tool park of Bulgaria. The necessary data are given in the following table, together with data for other countries with different levels of industrialization.

Type of machine tool	Bulgaria	USA	UK	Japan	Malaysia	Canada
Lathes	33	20.0	21.1	35	27.4	18.4
Milling	12	12.2	12.2	10	3.3	10.2
Drilling	23	19.3	21.9	22.3	22	19.9
Boring	1.8	2.3	3.2	2	0	4
Grinding	8.2	18	15.8	13.3	13.8	19.2
Cut-off	4.9	8.2	5.7	--	6.6	10.8
Planers & Shaping	1.7	1.5	2.9	1.2	7.2	2.8

* The figures represent the import of the country between 1961 and 1972.

The analysis of the figures for the Bulgarian machine tool park shows that in most respects the country has reached the optimum level, while the shares of some machine tools may be improved. So the ratio milling machines to lathes is 1:2.75 what may be considered quite proper. The share of the drilling machines is similar to that of the highly developed countries. The same applies for the share of the boring machines, shaping machines and planers.

The percentage of the grinding machines and cut-off machines is lower than in the other countries considered in the example. Partially, this is due to the increased in the last years use of automatic and semiautomatic specialized grinding machines. In the same time, this figure may be used as an indication that the grinding machines production should be increased on account of some other machine tools.

It should be noticed, that the shown as an example distributions of machine tools may not represent the best ones. Use of these values should be made only after careful consideration of the particular conditions in every case.

The next feature to be considered in analysing a national machine tool park is the amount and share of the high productive machine tools. To the above belong the automatic, semiautomatic, copying units and the very important numerically controlled /NC/ machine tools which made almost a revolution in the metalworking because of their superior capabilities. Currently all highly or less developed countries are increasing the number of the high productive machines they operate. For example in Bulgaria, on 1.1.1975, 18.5% of the machine tool park consisted of such efficient units. According the state plans, the share of the high productive machine tools has to be extended as indicated:

On 1.1.1975	On 1.1.1981	On 1.1.1986	On 1.1.1991
18.5%	30.7%	42%	52.3%

It is expected that these figures will be achieved mainly by increasing the national production, the remaining part imported.

One of the problems of the developing countries is the introduction of the high productive, and particularly the NC machines, at the early stage of their industrialization. The great influence of the decision on the metalworking industry requires a more detailed consideration of the pros and cons concerned.

THE SIGNIFICANCE OF NC MACHINE TOOLS

In 1955 the first commercial models of numerically controlled machine tools were displayed at the National Machine Tool Show in the USA and placed into factories for operational use. By 1957 NC machine tools were used to an extent that provided an important impetus to the national production. Work on NC machines was carried on also in Japan, German Democratic Republic, the Union of Soviet Socialist Republics, the Federal Republic of Germany, United Kingdom, Bulgaria and other countries.

According to some estimates, in 1969 there were more than 10,000 NC machine tools in operation throughout the world. This quick expansion was a result of the obvious advantages the NC machines demonstrated. They were much faster, more accurate and far more versatile than the conventional machine tools they replaced.

Paralleling with the attractive advantages, some negative features of the NC machine tools made the shop managers cautious. The main obstacle was the high cost of the machines which required high initial investments. Here is the explanation how a very popular misconception came to existence. It was, and still is thought by some people, that NC machine tools would return the investments only if big batches have to be machined.

The real picture is quite the opposite. The main reason for the success of the NC machine tools is that they are economically justified when batches over 30-50 workpieces are to be machined. The economy comes from:

- a- greater accuracy and the reduction of quality control costs /time and measuring instruments/.
- b- considerable reduction of the required amount of jigs and fixtures.
- c- sharp reduction of human errors and of the scrap.
- d- greater machine utilization.
- e- possibility to use less skilled labour.
- f- possibility for the operator to work on more than one machine.
- g- reduction of the set-up time.
- h- greater safety for the operator.

About 7% of all metalworking production consist of batch quantities suitable for NC machining and it is proved by the experience that NC machines are used successfully in large plants and small machine shops. According to ILO sources, the NC machines return the investment before expiring of 2 years in 20% of the cases, before expiring of 3 years in 67% of the cases, and it takes 5 years in 3% of the cases.

Special attention has to be paid to some management problems related to the use of NC machine tools. Numerical control should be considered as a complicated manufacturing system requiring a great deal of cooperation from all departments. There must exist an excellent connection between the shop, the programming, the engineering personnel and the maintenance technicians. In order to have proper return of the investments, the NC machine tools have to be operated at least two shifts, preferably three shifts.

The scale on which the developing countries should adopt NC machines depends on the particular conditions. For mass production they are not suitable, while for the general engineering industry they can play the principal part as the years progress.

INFLUENCE OF THE MACHINE TOOL PRODUCTION ON THE ECONOMY OF THE DEVELOPING COUNTRIES

Even the most developed country can not produce the required for its economy number and variety of machine tools. This applies all the more for the developing countries, which have to import all or major part of the machine tool they need weakening their resources of foreign currency. The logical step in this case is to establish own machine tool production or to develop further the existing one. The benefits of such policy can be briefly summarized in the following way:

- a- satisfying to some extent the requirements of the local metalworking industries.
- b- providing employment for a considerable amount of labour force.
- c- foreign currency earnings.
- d- creating of local staff of skilled machine tool manufacturers.

Once the decision to establish national machine tool production is taken, the developing country has to decide whether to buy licences or to develop own designs. For "beginners" there is only one alternative, and that is to look for foreign help. Due to the lack of experienced staff in the various fields related to the machine tool production, they have to purchase licences and know-how and to employ experts from abroad. Such approach was accepted by many developing countries and proved its properness. For countries with more developed machine tool industry this line of action may be limited or completely abandoned. In this case the policy depends on whether the considerable financial burden of such contract would be exceeded by the advantages it gives:

- a- the country has the opportunity to adopt an up-to-date machine tool without having to pass through the long period of research, experiment and adaptation experienced by the seller.
- b- the introduction of new materials, new technology and new design ideas gives a strong push in the development of local engineers, managers, operators, quality inspectors, economists etc.
- c- the adoption of a competitive machine tool gives the country the full chance to export this model. The benefits of this should not be considered only from financial view point, i.e. the foreign currency income. The exposure of a product to the world market brings also indirect gains for the industrial development since competition with similar products requires excellent design, perfect manufacture and high quality at reasonable cost.

DEVELOPMENT OF THE METALWORKING INDUSTRIES IN BULGARIA

About the end of the second world war, Bulgaria was an agricultural country with poorly developed metalworking industries. There existed a very limited production of primitive universal lathes, bench drills, shaping machines, welding generators, small presses, printing machines, equipment for the food processing industries etc.

One of the first steps of the new postwar government was to create a powerful metal working industry with special emphasize on the machine tool industry. It was decided to put together the machine tools and the personnel of fourteen small private enterprises and to form a strong machine tool plant. This happened in 1947, which year is considered as the birthday of the Bulgarian machine tool industry.

Initially the new plant produced the same production as the incorporated units, but in 1950 was designed and produced entirely with national efforts, an up-to-date universal lathe. Until 1972 only in the plant having already the name "ZML", were designed and produced more than 20 types of universal and production lathes, more than 20 types of various bench and column drilling machines, about 15 types of milling machines, several types of grinding machines and also shaping machines, different out-off machines, slotting machines and the new thread broaching and gear chamfering machines which were patented abroad.

For this quick development helped considerably the Soviet Union, Czechoslovakia and some other countries. They contributed with supply of the necessary machine tools, sending of experts, transfer of know-how, providing of materials.

After the machine tool plant ZML obtained adequate experience and self-confidence, the government decided to make new big investments in establishing other machine tool plants. These plants became to appear in various parts of the country and were initially dependent on ZML. The ZML fulfilled the role of "mother" plant, which designed certain machine tool, started its production and then transferred it together with know-how and the tooling equipment to the future manufacturer. In the course of several years many of these plants became self-sufficient in respect of design capabilities and manufacturing.

In the mean time in the country already existed many and highly qualified specialists and it was decided to create a design and research institute in the field of the machine tools. This institute was supposed to carry out scientific and research work, and to continue the work started by ZML - to design machine tools, produce prototypes and give them to certain plant.

The new organization gave good results in the further development of the machine tool industry. In 1968 was started production of first programme controlled semiautomatic chuck lathe. Now about

ten types of automatic and semiautomatic lathes of various sizes are operating abroad and in Bulgarian plants. In 1976 began the serial production of the first NC lathe. Now the Bulgarian machine tool industry is producing special purpose, unit composed machine tools, machining centres, transfer lines, industrial robots and manipulators and systems of machine tools. In order to keep in line with the world trends in machine tool building, concerning designs, know-how, electrical equipment and materials were purchased from leading firms.

The constant efforts to produce competitive machine tools promoted conditions for intensive export. The main items of the export are programme-controlled lathes, universal engine lathes, drilling machines, milling machines, presses, cut-off machines.

The intensive development of the machine tool industry provided a solid ground for growth of metalworking industries. The long-term planning and the great investments allowed to develop sharply the existing in the country metalworking industries and to create new branches. A favourable effect on the metalworking in Bulgaria had also the cooperation among the COMECON countries. According a general agreement, comprising the manufacturing of a great amount of products, a specialization of each country in certain branches was promoted. The participation in the agreement gave two important benefits to the Bulgarian metalworking industry:

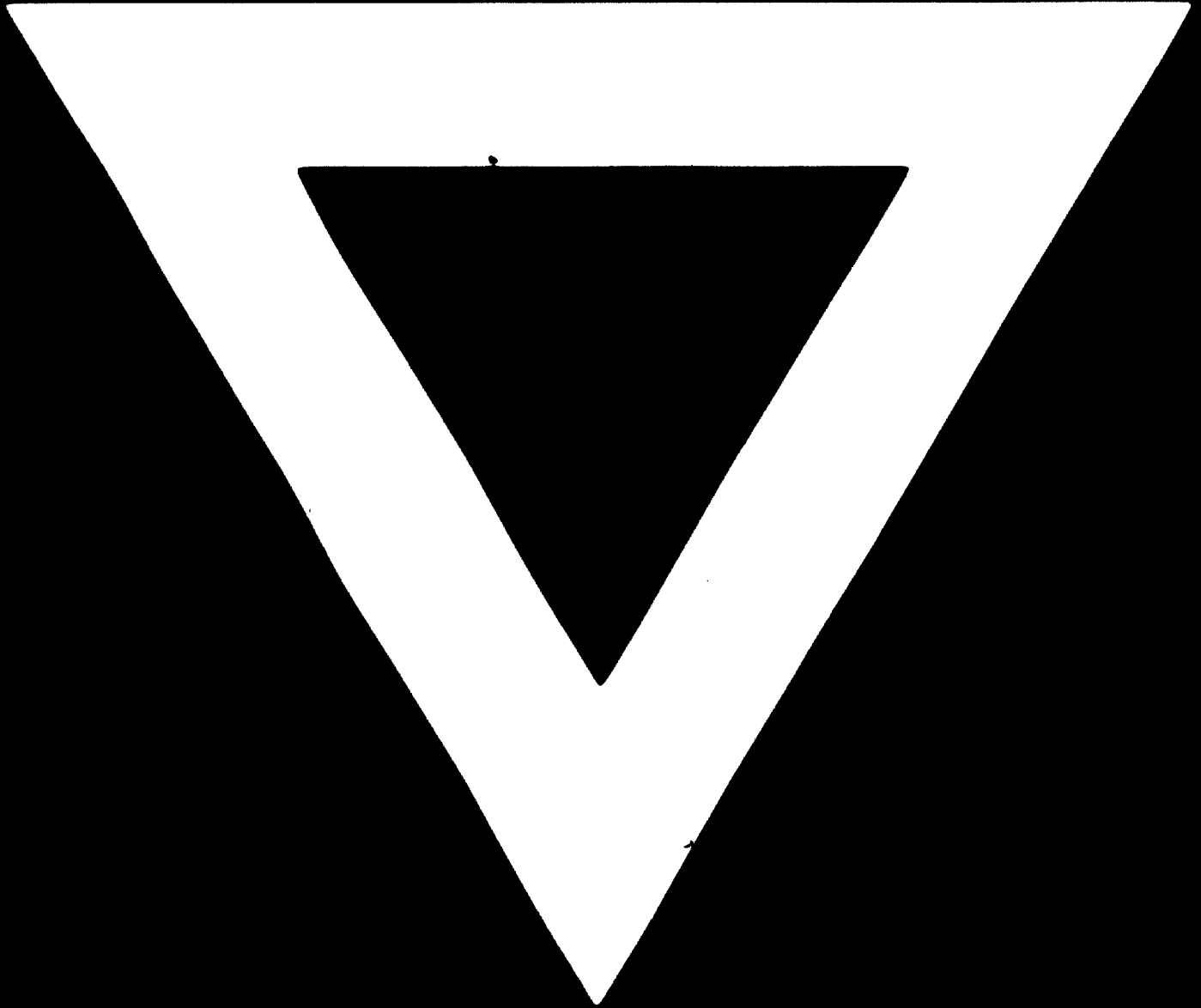
- a- possibility to plan and develop a large scale production having a guaranteed market for the product.
- b- reasons to invest heavily in creation of high productive plants, expecting quick return of the capital.

Today Bulgaria produce and export a big variety of products, among which of greater importance are:

- fork-lift trucks, electrical and diesel.
- electrical motors.
- ships.
- trolley hoists.
- food processing equipment.
- agricultural machines.
- machines for the textile industry.
- household appliances.
- storhouse equipment.
- pressure vessels.
- containers.
- metalcutting tools.
- measuring instruments.
- presses.
- railway wagons.
- turbines for hydro power stations.



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