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# TRANSLATION

ECONOMICAL EFFECTIVENESS OF GROUP  
MACHINING METHODS

By

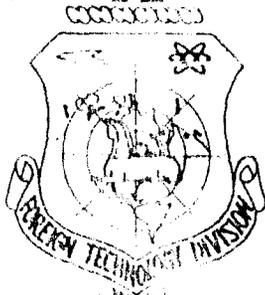
A. Ya. Bel'chenko and G. G. Yatsenko

## FOREIGN TECHNOLOGY DIVISION

AIR FORCE SYSTEMS COMMAND

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## UNEDITED ROUGH DRAFT TRANSLATION

ECONOMICAL EFFECTIVENESS OF GROUP MACHINING  
METHODS

BY: A. Ya. Bel'chenko and G. G. Yatsenko

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## Economical Effectiveness of Group Machining Methods

by

A. Ya. Bel'chenko and G. G. Yatsenko

The economical effectiveness from the introduction of group methods can be divided into direct and indirect, into factory and outside factory. The outside factory effectiveness is usually only indirect.

It should be pointed out, that the economy from a more rapid introduction of new machines into national economy, assuring the introduction of new highly productive processes (in comparison with old processes), appears to be, as a rule, very great, indirect economy can exceed by tens of times direct economy.

At present time is considered only direct economy and the effectiveness thereof. In conformity with this we shall discuss below certain methods of determining economical effectiveness, recommended by VPTI of Leningrad and the proposed by A. Ya. Bel'chenko method of determining the labor saving economy by the introduction of group methods.

This method is of great importance, because economical problems are closely connected with technical and should be based on them.

It means, that to calculate economical effectiveness it is necessary to examine the conditions of introducing group machining assuring maximum economical effect.

We shall briefly discuss certain prerequisites, which should be taken into consideration when determining economical effectiveness of group methods.

It is necessary first of all to take into consideration, that at the modern stage of development of economical sciences calculations of economical effectiveness appear to be more or less valid only in the case if they are applied to concrete conditions and are based on real data.

Consequently, a reliable calculation can be made only for each concrete case.

When calculating the economical effectiveness of employing group machining the enterprises should utilize data taken from factory practice and the standards prevailing at plants.

To determine the possible economical effectiveness of employing group machining at planning enterprises it is necessary to employ data of leading outfits of given branch.

When determining effectiveness of group machining it is necessary to take into consideration the real conditions of group manufacturing, including the characteristic features of organizing group manufacture.

A mechanical transfer of conventional manufacturing conditions into group conditions leads to greater errors and reduces to nothing the value of all calculations of economical effectiveness.

One of the important conditions of employing group methods is the economy of human labor. To this condition was not given too much attention in the investigations of group methods.

For example, in the investigations by S.P. Mitrofanov and others is recommended a greater number of structural contrivances for group machining with hand operated clamps. As a result of employing such contrivances there is a considerable reduction in the degree of effectiveness of group machining.

There will be absolutely no gain in economy by cutting auxiliary time. Further more in some constructions of contrivances the auxiliary time may even rise.

Possible are the following cases of determining the real economical effectiveness by using group machining, when:

- 1) it is necessary to determine the economical effectiveness of an already introduced group machining, in comparison with previously used non-group machining (attentive effectiveness);

- 2) it is necessary to determine the possible economical effectiveness of pro-

posed introduction at given plant group machining in comparison with the used conventional methods (proposed effectiveness); so far there are no appropriate data pertaining to mentioned technology and time standards;

3) it is necessary to determine the possible effectiveness of the mentioned application at a planned (nonexistent) enterprise of group machining.

In the first case is recommended the use of the VPTI Leningrad method; in the second - the method introduced by A.Ya.Bel'chenko (in labor consuming department); in the third case is necessary to utilize data of enterprises of given branch with determination of labor saving economy according to the A.Ya.Bel'chenko method.

The VPTI Leningrad Method. This method explained in "Guide book on the Calculation of economical effectiveness of Group Manufacture in Machine and Tool Construction".

The method contains instructions in calculating the effectiveness of introduced group manufacture and instructions to calculate the anticipated economy from planned introduction of group machining.

In the second case the calculations are made on large scale by the orientation indices given in the guide book.

The method is based on the following basic conditions.

The basic characteristics, measuring the economical effectiveness of group manufacture, appear to be production costs and time of recovering the additional single investments.

Economical effectiveness is calculated on the basis of natural and cost indices.

The economical effect is calculated in form of conditional annual economy.

In cases where consideration is given to the economical effectiveness by replacing a billet, obtained previously from a bar subjected to milling, by a billet obtained by other forms of machining (casting, cold and hot forging), it is necessary to determine the total production cost of the shop.

When calculating it is necessary to provide a comparison of cost indices, wherefore the basic data must contain corrections to bring same into identical conditions.

The collated results of calculations should be formulated by the group arrangement.

At a greater nomenclature of less labor consuming details it is permitted to make a calculation by typical representatives with dissemination of results over all details of the group.

To formulate calculations of economical effectiveness the VPTI Leningradskoye developed typical forms (see appendix).

According to examinations made by the authors of this book, the VPTI Leningradskoye method appears to be suitable and appropriate in case of determining the economical effectiveness of already introduced group machining in comparison with the previously used conventional method.

For enlarged calculations and to determine the anticipated economical effectiveness of the proposed introduction of group machining it is unsuitable, since it does not consider the concrete conditions of each individual enterprise.

Method of rapid and simplified determination of economical effectiveness. The existing methods of determining the economical effectiveness of group manufacture are basically appropriate only for the evaluation of already introduced group machining.

It is necessary to know the new labor difficulty in machining details, but for this it is first necessary to develop a new group technological process, establish working conditions.

It is necessary to have an outline and the cost of the equipment and the expenditures for its repair and operation. In cases, where there is no developed and approved price list for the equipment, this cannot be established even approximately, without having first constructed the entire equipment.

Consequently, preliminary determination of economical effectiveness by such a method is actually impossible.

It is possible, it would appear, to use data from other enterprises concerning the cost of new group equipment.

For this purpose in the above mentioned text book of the VPTI Leningradskoye are given data about the average cost of group equipment in rubles per unit (and actual group complexity of attachments for machines). But any industrialist knows well, how considerable are the differences of one and the same piece of equipment, manufactured at different plants, how different are the concrete conditions of each plant.

At an existing method of determining the economical effectiveness the role of the economy is purely passive - to determine the ready results of introducing group methods.

In this way economy is deprived of any given influence on technology, it evaluates only ready results.

Proposed is a new method of determining the economical effectiveness of applying group methods, which can be called the active method of determining economical effectiveness. The method allows to determine not only the effectiveness of already introduced group machining, but also to determine with very great accuracy the effectiveness of group machining intended for application, which is of very great practical importance.

Conventional methods of determining effectiveness of group machining call for the presence of a whole series of data, which can be obtained only after the introduction of group machining methods.

This method is recommended for preliminary determination of economical effectiveness during mechanical machining by cutting.

The method appears to be perspective, since it takes into consideration the tendency of modern technology in metal machining to the rise in the fraction of auxiliary time in general time of machining in connection with the use of high speed and power milling.

We shall discuss the most characteristic case of the mentioned introduction of group machining.

Assuming the plant is employing basically universal devices. In this case it is necessary to make provisions for the introduction of group high speed appurtenances (pneumatic, hydraulic etc) The main economy here will be obtained by reducing the auxiliary time (mainly on account of reducing time of setting, releasing and fastening of machined details).

The expenditures for equipment may also rise; e.g. if at existing technology only universal equipment was used, then at group technology should be used group or universal fixing equipment.

To evaluate the reduction in machining time it is necessary to analyze the advisability of employing a multibladed milling tool instead of a single bladed tool and the level of cutting conditions, actually employed at working places.

According to observations made by the authors at certain enterprises the laborers employ cutting conditions, considerably differing from the ones mentioned in technology,

some of the enterprises have no technological or technologically standardized charts with conditions of cutting, it is therefore absolutely necessary to check the actually employed cutting conditions.

If it will be found that the employed cutting conditions are not below standard (progressive standards should be used), and are even higher, then there are no bases to expect that it will be possible to considerably improve the conditions.

The basic economy in this case will be obtained by reducing the auxiliary time.

In cases when the level of cutting conditions is low, it is necessary to establish, by how much the used conditions are lower than the progressive. On the basis of this it is necessary to introduce a correction coefficient for the machine time.

Basic economy will be obtained by reducing the spare time and machine time. But the spare time economy will in individual instances exceed the machine time economy.

The order of enlarged calculation of the expected economical effectiveness from introducing group adjustment with high speed contrivances is as follows.

All details, subject to change over into group machining, are divided into groups (method of group formation see in corresponding chapters of the book).

For each machine is compiled a combined knowledge of machine and spare time (by actually effective standards).

Machine and spare time is summed up separately.

To determine expected machine and spare times for the group are possible two methods.

Direct, at which by calculation-analytical or accelerated method is determined the machine and spare time for a typical representative of the group. This mean time is distributed over all the details of the group. The difference between the actually consumed time per detail of the group and the anticipated will give time economy.

Indirect, at which is checked the level of cutting conditions and is established the machine time coefficient per each group. By multiplying the sum of actual machine time (per all details of the group) by the coefficient is determined the anticipated machine time per group. The difference between the time according to effective standards and the anticipated represents an economy of machine time per group:

$$T_{econ,mach.} = T_{mach.group} - T_{mach.group} \cdot K.$$

Determined is the difference in spare time per detail of group, originating as result of employing high speed contrivances (e.g. for setting, clamping and removal from contrivance at improved contrivance with pneumatic clamps instead of 2 minutes is consumed only 0.3 min). The result is distributed over all details of the group by the annual program:

$$T_{econ,spare} = m(t_{spare.old} - T_{spare.new}).$$

where  $m$  is the number of details in the group.

To calculate the economy in labor consumption special calculating data are necessary (table 21)

To formulate a general effectiveness it is OK to use the VPTI Lencovnarkhoz forms

(see appendix).

Table 21. Calculation catalogue to determine economy in labor consumption for the machining of details as result of planned introduction of group machining\*

Name of group	No. of details per group in annual program) units	Stand aerd hrs by actual standards per annu- al progr.	Calculation of labor expenditures at group machining				Total annual economy in stand-hrs per given group	On account of what is observed economy per given group		
			coef	Mach. time per ann prog hrs	Mach. time econ. hrs	Spare time econ. hrs		Mach time	Spare time	
Shafts	5000	5000	7500	0,7	3500	1500	0,8	4000	5500	Modernization of two machines with installation of hydraulic copy mach. support and pneumatic pinoles in rear headstock

\* a standardized group is under consideration.

#### Organization of Introducing Group Machining Methods

Investigation of the method of introducing group methods shows, that these methods during their introduction without any system, each enterprise must spent greater efforts, time, means and they do not always offer results. Each enterprise undergoes constantly all stages of introduction, repeating all errors and deficiencies. Known is a case, where certain enterprises begin three-four times introducing group methods, before they even attained any definite successes. And, ~~vice versa~~, enterprises and sovmarkhozes (Council of National Economy) introducing group methods in accordance with a specific plan, have attained greater successes. As an example could be mentioned the Leningrad sovmarkhoz.

It can be stated with great confidence, that most advisable would be the introduction of group methods in centralized order, according to one plan, employing all ad-

vantages of planned economy and its features, emanating from the new forms of industrial control.

Of greater interest in this respect are the measures of the Leningrad sovmarkhoz, which solved a whole series of complex problems of structural and technological nature when organizing group manufacture at plants. And so for example, at structural organizations and construction bureaus of plants were organized groups on unification and standardization of details and individual structural-technological elements. In connection with this was introduced a system of drawings control, limiting the nomenclature of details and their elements when developing new machine constructions.

At enterprises was organized a special bureau (groups) dealing in the introduction of group methods.

At the planning-technological institute is set up a branch of group and typical technology, the purpose of which is to generalize the experience, offering technical aid to enterprises and scientific solving of perspectives for the development of group and typical technological processes, organization of seminars for factory workers for the study of group methods, organization of publishing brochures and placards reflecting the experience of introducing group machining methods at enterprises of the sovmarkhoz.

But the development of group adjustments, design and manufacture of group equipment is done by individual enterprises on the basis of individual plans of introducing group methods. This appears to be a great shortcoming, since the basic advantages of socialistic economy and forms of industrial control are not utilized and to a very low degree are utilized the possibilities hidden in group methods.

Under modern conditions are possible three different forms of introducing group machining methods:

1) decentralized, when group methods are introduced by each enterprise individually, separate from other enterprises;

2) centralized (on scale of specific economical administrative region), when

the introduction of group methods should be carried out in accordance of one plan for all enterprises for the given Council of National Economy). Of course, a centralized methodical guidance and centralized technological industrial preparation should be provided (providing single technological documentation, centralized preparation of group equipment etc.);

3) centralized, on the scale of the republic) generalized planning, guidance and carrying out of technological preparation for the introduction of group methods.

It is natural, that most perfect appears to be the second and third forms. Possible, of course, are certain other variants. For example, it may become advisable to combine the second and third forms, when, for example, on the scale of the republic is centralized the solution of principal problems (general planning, single documentation, centralized manufacture of group equipment), the remaining problems can be solved on the scale of individual sovmarkhozes.

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