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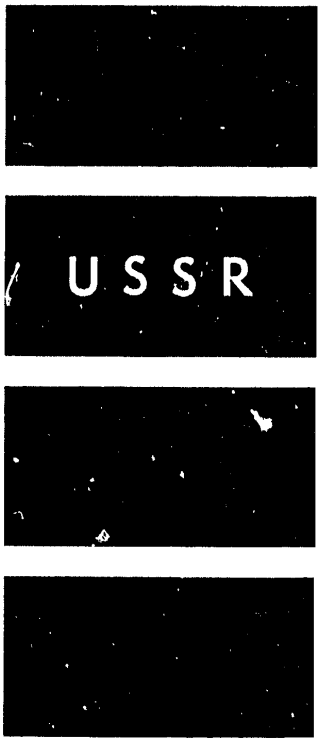

TRANSLATIONS ON USSR ECONOMIC AFFAIRS

(FOUO 2/79)

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CONTENTS

PROGRAM-GOAL PLANNING ON SECTOR LEVEL

Moscow VOPROSY EKONOMIKI in Russian No 12, Dec 78 pp 23-33

/Article by E. Yefimova: "Program-Goal Planning on the Sector Level (Using the Example of Scientific and Technical Programs)"/

/Text/ The methodology of the program-goal approach as one of the ways of making a systems analysis in economics is still in the process of being developed. The development of programs at the level of the sectors of the national economy and industry remains the least studied field in the methodology of the program-goal approach in planning, although the solution of these problems is of exceptional importance owing to their decisive influence on the entire course of planning of the national economy.

Each program is a set of measures, which is complete in time and space, with distinct results which yield to comparison with the demands for resources. For all the diversity of programs there should be embodied in them one of the dominant features of the program-goal methodology--the coordination of the goals with the resources. Meanwhile often the distribution of resources is outside the competence of the compilers of one program or another, therefore it is possible to determine for far from each of them the ways of providing resources of various types, in the assigned amount and of the required quality. The failure to observe this condition can threaten the achievement of the set goals.

In order to implement the programs, which do not depend on the compilers and go beyond the sector, along with the development of the general methodology of program-goal planning the need has arisen to study its peculiarities on the sector level. Until recently there predominated in economic literature a one-sided approach to program-goal planning, in which the program as such, and not the sector implementing the program, was taken as the object of study. In connection with this many questions of the program-goal planning of a sector and above all its provision with resources remained outside the field of vision of investigators.

At present there is no generally recognized classification of programs. In the available literature programs are classified depending on the level

of the object (interunit, national economic, sectorial, of individual enterprises, associations); the nature of the problems being solved (socio-economic, scientific and technical, production technology, operational organizational and so on); the territorial sphere of their effect (all-union, regional); the period of their implementation (short-term, intermediate-term, long-term) and others.[1] In our opinion, in addition to this, in principle correct, but arbitrary grouping on the sector level there should be added the division of programs into global programs, which embrace a set of interconnected problems and ensure the completeness of the development of a relatively closed object (a system, a subsystem, an element of a system) at each level of its operation, and local programs, which are aimed at the solving of any one special problem which facilitates, but does not determine the development of the given object.

The scale of the program has a substantial influence on the development of the system and is one of the important features which govern the differences in the structural arrangement of the programs, the degree of their detail and the means of distribution of the resources. The reduction of unfinished construction, for example, is such a global problem for construction. As a local problem it is possible to formulate the following problem: the increase by 1990 of the proportion of efficient types of brick in its total production volume to 80-90 percent.

The program-goal approach can be used with the greatest impact for solving problems of a global scale, that is, problems determining the development of the sector as a whole. In this case the conditions are created for embracing and viewing the entire system in question, in connection with which it seems possible at least to determine precisely the demands for basic resources and the demands on related sectors.

Scientific and technical programs constitute the majority of the "mass" of existing programs, therefore we consider it feasible to examine the problems of program-goal planning on the sector level using the example of scientific and technical programs. All the more as the methodological principles and "technology" of the drafting of scientific and technical programs have no substantial differences from the principles and "technology" of the drafting of programs of other classes.

The scientific and technical program is a set of measures which are interconnected according to the performers, resources, place and time and are aimed at the solution of a scientific and technical problem. Some authors consider as an obligatory feature of the scientific and technical program its coverage of all the phases of the "life cycle" of the object--from the scientific idea to the mass dissemination of technology. In this definition those interconnected sets of measures, which are concluded by the creation of a pilot model or ensure the increase of knowledge, cannot be considered scientific and technical programs. Therefore, in our opinion, it is impossible to agree with this point of view.

A scientific and technical program can be designed for the solution of a purely scientific problem which does not have at present the economic prerequisites for mass utilization (for example, the program of a controlled thermonuclear reaction). Thus, among the scientific and technical problems which are approved at the national economic level and are subject to program development there are also other, purely scientific problems: the study of the world ocean, the study of the principle of superconductivity in magnetohydrodynamic generators and others. Evidently, it is feasible to divide scientific and technical programs into: a) strictly scientific programs, which have as a goal the increase of scientific knowledge; b) scientific and technical programs on the development of pilot models of new equipment and technology; c) scientific and technical production problems of the mass dissemination of new equipment and technology.

Of course, the need of the various types of scientific and technical programs for resources is different in principle. For the implementation of programs of the first type skilled scientists and experimental facilities are needed, for the implementation of programs of the second type design and planning personnel and the capacities of pilot plants are also required, in the third case all resources, including capital investments, are required in practice. The scientific and technical programs of the latter type are the most effective ones, which are conducive to the acceleration of scientific and technical progress.

All programs, no matter what class and type they are attributed to, should be a directional planning document and should form an independent program-goal section of the plan, which is coordinated with its sectorial and territorial sections. The practice exists of including the requirements of programs in the corresponding sectorial and territorial parts of the five-year plans without distinguishing in the plan an independent program-goal section. If the program assignments could be ensured within the traditional structure of the plan, there would be no need to draft programs. In this case the resource-goal orientation of the plan and the possibility of ensuring the priority of the programs disappear.

At present there are contradictions in the mechanism of coordinating the resource-goal orientation of the plan with its sectorial breakdown. Therefore it is necessary to limit the number of problems, for which programs are formulated, to the most important ones which do not yield to solution by the traditional method of planning. In this connection the existence on the national economic level of more than 200 scientific and technical programs is hardly justified.

The point of view that goal programs should form a program breakdown of the plan is now becoming generally recognized. However, in practice they are still a preplanning or "extraplan" document. The majority of the 11 goal programs existing in the Latvian SSR were approved by the republic Council of Ministers with the instruction to the republic planning organs to find in the five-year plan resources for their implementation. But the resources

were not found in the necessary amount, so it was necessary to make substantial changes in a number of programs after the approval of the 10th Five-Year Plan. Thus, the Latvian SSR Gosplan was forced to subject to adjustment the comprehensive program aimed at the increase of the efficiency and quality of construction.

The lack of a special program breakdown of the plan had the result that a number of scientific and technical programs included in the State Five-Year Plan for 1976-1980 are not being fully implemented. A check made by the State Committee for Science and Technology showed that at the lower "stages" of planning, in the ministries and departments, a number of assignments stemming from the indicated programs were not included in their five-year plans.[2]

As is known, the steps on providing the programs with products being developed by the sectors of the national economy and industry usually act as measures in the programs. In this very way the sectors are connected with participation in programs of all classes. In additional to the drafting of their own intersectorial and intrasectorial programs, they are suppliers of products for programs of interstate, national economic and regional importance and so on. The measures are at the meeting point of the programs with the resources.

In the drafting of comprehensive goal programs at the national economic level the stage of the measures of the indicated scheme by analogy with the goal one can be represented also in the form of a tree of measures, which is the logical continuation of the tree of goals and tasks and represents a set of actions which are interconnected for the fulfillment of the general task. The construction of the tree of measures and the drafting of the program itself in this area entail particular difficulties. At the stage of the elaboration of the measures an interweaving of the ties is found both within the sectors owing to the servicing of different programs and between the associated sectors, which leads to the delay of the introduction of program-goal planning on the sector level.

The coordination of the goals with the resources offers the greatest difficulties. Additional difficulties of distributing resources between the demands of the programs and the requirements of extraprogram development of the sectors, as well as of coordinating the resources among the individual programs arise. For example, the program "The Timber Resources of the Latvian SSR and Their Complete Use and Reproduction" provides for the production instead of lumber of efficient large-size building plywood, while the program "The Increase of the Efficiency and Quality of Capital Construction" is directed toward the receipt of traditional materials.

Many of the scientific and technical programs in effect during the current five-year plan are of an intersectorial nature, but one (parent) sector is their developer. It is hardly in a position to look into the question of providing production resources even to that part of the program, which

contains the obligations of the parent sector itself. Precisely the difficulties of coordinating the goals with the resources on the sector level serve as the reason for the lack in the majority of scientific and technical programs of the stage of the mass introduction of scientific results in production.

In order to overcome these contradictions when formulating the specific programs at the stage of the elaboration of the measures, that is, at the sector level, it is necessary to determine the place of the sector in the national economy, in the overall flows of resources and products, the nature of the participation of the sector in the program and the role in its implementation.

From the point of view of program-goal planning it is possible to specify the following functions of each sector: 1) the fulfillment of the orders directly for the implementation of programs of the national economic level; 2) the fulfillment of orders of other sectors, which are connected with the implementation of national economic programs; 3) the fulfillment of its own intrasectorial programs; 4) the production of products for meeting the extraprogram demands of the national economy (within the framework of the traditional principles of planning).

The listed functions are governed by the nature of the interconnection between the sector and the scientific and technical programs. In fulfilling the national economic programs, in which the given sector participates directly or indirectly, the assignments of the sector can be expressed either in an impersonal form or as separate subprograms. In the former case the requirements of the program are formulated outside the given sector. The order is included in the general plan (without a detailed description of the characteristics), the evaluation of the fulfillment of which is made according to traditional indicators. In order to fulfill the entire plan, including the assignment "dissolved" in it, the appropriate departments elaborate the necessary measures. In the latter case the assignments of the sector can be expressed in the form of an integral complete subprogram, which has been elaborated at all stages, including the stage of measures, when along with the order for products (with the assigned quantitative and qualitative characteristics) the ways and means of ensuring their production are outlined and set down, or in the form of an order for products (also of specific quantitative and qualitative characteristics) outside the general program. In this case the elaboration of the measures on ensuring the production of these products rests on the corresponding department.

The general assignment of USSR Gosstroy on participation in the drafting of a program on the introduction of methods and technical means for the building and operation of projects of the petroleum and gas industry under permafrost conditions can serve as an example of the first form of assignment. In this program it is not indicated what specifically Gosstroy should do. The relatively specific assignments of the USSR Ministry of Ferrous

Metallurgy on the expansion of the variety of oil pipes, which are contained in one of the scientific and technical programs of the petroleum industry, can serve as an example of the second form.

Given all the forms of the establishment of assignments for sectors the complexity of their planning, which consists above all in the sectorial nature of planning, is maintained, while the program is an instrument of intersectorial importance. The dissociation of the sectors does not make it possible to establish all the ties and to ensure the total coordination of their activity. Therefore, it is more feasible to solve the problems of program-goal planning on the sector level within the framework of intersectorial complexes. Here it is necessary to differentiate two types of complexes: permanent ones and sporadic ones.

Complexes of the first type are consolidated, relatively isolated productions units of a number of sectors, which are interconnected by permanent technological and functional attributes. They are stable projects of planning. The composition of the complexes is determined by the similarity of raw materials or the vicissitude of the manufacturing process, the purpose of the products and so on. At the same time there are no strict criteria of the evaluation of the intensity of the ties owing to their diversity.[3] For some sectors it is comparatively easy to determine the closeness of the tie. For example, the production of construction materials, parts and structures is integrally firmly connected with construction, the timber industry--with the wood processing industry. At the same time in a number of instances the ties do not appear that clearly, and the formation of complexes creates difficulties. In spite of the inevitable conventionalities in the formation of complexes of the first type, their creation yields great advantages in the management of the economy and the introduction of the program-goal method of planning and, what is the main thing, does not require serious organizational rearrangement.

Complexes of the second type are aimed at the fulfillment of specific programs. In them any combination of sectors occurs, since the tie between them is of a sporadic nature. Unlike complexes of the first type, the creation of less stable complexes involves some reorganization of planning and management. The quality and degree of realization of the goals depend on whether the creation of such complexes is of a purely analytical nature or whether their formation will entail some organizational rearrangement.[4]

In conformity with the concept of program-goal planning at the level of the sectors of the national economy or industry the resources are transformed into products. Here the nature of the resources at the sector level is different than at the national economic level. At the national economic level the resources appear in an aggregate form: natural, labor, financial (capital investments are included here), information, as well as productive and nonproductive capital. However, at the sector level the disaggregation of resources is necessary, for example, the discrimination from the overall stocks of iron ore of the ore with special qualitative characteristics or from the total staff of workers of workers with specific specialties.

In addition to the indicated difference, there is another peculiarity in the concept of a resource at the level of the sector. For a sector the product (output) of another sector serves as a resource (input). The consideration when drafting scientific and technical programs of the disaggregated resources and those which are the product of other sectors is connected with the intensification of the effect of the factor of uncertainty. In evaluating the possibilities of providing such resources the uncertainty to some extent can be eliminated only after the completion of the process of planning in all sectors and links of the national economy. Therefore, if for the sector the limits of the aggregated resources are even known (at the first iterations of the work on the program), the coordination on their basis of the goals and potentials is not guaranteed.

Unfortunately, the ways of distributing resources, which are presented in the literature on program-goal planning, are oriented precisely on aggregated resources (primarily financial resources). For example, the means of solving this problem, which is proposed by a number of authors, pertains to the goal stage of the drafting of national economic programs, is oriented toward aggregated resources and therefore does not solve the indicated problem.[5] The model recommended by a group of other authors reflects to some extent the coordination of the overall goals with their immediate performers. It includes the elaboration of a network schedule of the time lags for the participating sectors and the establishment of the sequence of the stages of the processing of the objects of labor into the final product, which conforms to the goal standards and goal indicators. The optimum task for a minimum of expenditures of resources with the preset time of performance of all the operations and its individual stages is solved on the basis of the schedule. The coordination of the goal indicators with the resources is accomplished through an intersectorial balance by means of iterations.[6] It seems that this approach is a step forward in the solution of the problem of program-goal planning on the sector level, although it does not entirely solve it. A network schedule is elaborated for those sectors which are direct participants in the implementation of the programs. The disadvantage of this approach is that the products produced by the participating sectors are only a part of the total output of these products, while there is no mechanism in the indicate approach, which makes it possible to coordinate the demand for resources for the production of the program and nonprogram products. In addition to this it must be noted that because of its dimensions it is impossible to include in the network schedule the entire chain of associated sectors and operations. Therefore, the performers will be faced with the problem of establishing the bounds of association, which can lead to the disappearance from the program of a portion of the vitally important operations.

The implementation of the following interative plan, in our opinion, will be one of the possible ways of solving the problem of providing sectors with resources under the conditions of the introduction of the program-goal method of planning. At the goal stage of the drafting of the programs their demand for aggregated resources (resource-intensiveness) is determined on

an integrated scale. In turn, the planning organs on the basis of the available forecasts of the availability of resources establish the possibilities of the development of all sectors and the meeting of the requirements of the programs.

In the event of insufficient resources the need arises for their initial redistribution among the different programs. The limitation of resources at the initial stage of distribution faces planning organs with a choice: either to put off to a later time the achievement of some goals or others, to decrease the extent of achievement of the goal indicators in the outlined programs, or to slow proportionately the development of all sectors (or a sector taken separately) which are connected with the given resource for nonprogram needs. The procedure of making such decisions in principle cannot be formalized, as is specified by the authors in the above-mentioned schemes, since the decisions being made pertain to large systems with a set of diverse conditions of national economic development in one segment of time or another. Such a procedure is repeated many times until a complete balance for the specific resource is achieved. A similar scheme takes shape when coordinating programs with other resources.

Evidently, the following iteration of the cycles of the distribution of resources is expedient: initially the nonreproducible (natural) resources are subject to distribution (in aggregated form), since they can be expressed in physical and material form. Then it is possible to distribute the reproducible resources--first the capital investments, and then the products of the sectors of the national economy and industry. Of course, the results of each iterative cycle of the supply of resources might be uncoordinated, therefore in the process of shifting from one cycle to another coordination according to the same scheme as within the cycle is necessary. On the basis of the indicated process the central planning organ sets for the sectors the limits on resources for the fulfillment of national economic programs and for nonprogram needs. These limits should serve as the basis for the elaboration of program measures.

As to the sectorial programs which solve both global and local problems of the sector, their drafting should be carried out within the framework of the limit for the nonprogram development of the sector. Here, taking into account the small scale of the system and the great degree of its circularity, the use of formal methods of distributing resources, in particular with some modification of the means proposed by I. Popov and A. Fonotov, is possible.

The essence of this modification consists in the fact that along with the consideration of the coefficient of "relative importance," which makes it possible to determine the sequence of saturation with resources of the individual goals, when finding the optimum of the "discrepancies" (the degree of satisfaction of the goal standards of different goals) an additional indicator is introduced, which characterizes the resource-intensiveness of the programs, since the need of some programs for resources does not correlate with the degree of their importance. For a specific goal the level of the

resource-intensiveness for each type of resource will be different, in connection with which it will be necessary to make the calculations according to the indicated methods repeatedly according to the number of resources being distributed. The results of the distribution of each resource are also coordinated.

The advantage of the proposed scheme of the distribution of resources among individual programs when introducing the program-goal method of planning consists in the fact that the imp'ementation of the scheme provides for the gradualness of the transition from its traditional methods to its program-goal methods and does not require a "break-up" of planning. This will make it possible right now to start the drafts of individual programs with an orientation toward the supply of resources.

The above-described procedure of distributing resources pertains to national economic programs, that is, to the performance of the first two functions of the sector according to the gradation we adopted (see above).

The elaboration of the criteria for the selection of alternate solutions at each level of the realization of the goal is one of the complicated questions of the methodology of program-goal planning. For all scientific and technical programs, including intrasectorial programs, the choice of the criteria is made from the viewpoint of the ultimate interests of the programs with allowance for the peculiarities of the sectors participating in them.

The program-goal approach is aimed at the achievement of important national economic goals. In connection with this there is incorporated in its very content a mechanism for finding the most effective direction of national economic development according to a large number of criteria. At the same time the choice of some specific variants or others of the technical decisions in the sector can be made according to one criterion. At present the minimum adjusted expenditures serve as such a generalizing criterion of evaluation from the point of view of national economic efficiency. But from the viewpoint of the fulfillment of individual specific goals this is not enough.

The choice of variants according to a given criterion will promote the rational distribution of only one resource--capital investments. Meanwhile, in distributing another resource, which is necessary to the same extent for the realization of the given goal, the obtained set of variants might not be the optimum set. Therefore the evaluation of the efficiency of scientific and technical programs according to the amount of the annual economic impact as the difference in the adjusted expenditures as compared with the initial state of the problem in reality does not characterize their efficiency.

The examined questions of program-goal planning are especially urgent for such a sector as construction. The production technology of construction

differs sharply from the technology of other sectors of physical production. Its "attachment" to the land with territorial dispersion, the great duration of the production cycle, the diversity of construction projects, the lack of uniform physical measurers of the products and so on--all this governs the specific nature of construction as a participant in scientific and technical programs. Moreover, the role of a generator of a universal resource for goal programs, which construction plays, on the one hand, and the nature of the used reproducible resources for its own production, on the other, determine the special place of construction in the realization of programs.

The peculiarity of construction consists in the fact that the final product of this sector coincides with the concept of one of the most important resources necessary for the fulfillment of all scientific, technical, economic and social programs. Construction has a ramified network of production ties not only with numerous consumers of fixed capital, but also with suppliers of resources for it. The immediate primary resources for this sector--nonmetallic raw materials and labor resources, the bulk of the resources ensuring the production activity of construction--are the products of other sectors of physical production.

Construction consumes material resources in an extensive list, and if we add to this the material resources for the sectors of industry, which are included in the construction complex, it becomes clear that the determination of the possibilities of supplying them in the full amount does not seem possible. In conformity with this it is necessary to limit the required composition of the resources.

At the initial stages of the formation of both external and internal programs it is expedient to limit oneself to the determination of the possibility of providing general-purpose aggregated resources, to which capital investments and labor resources belong. Moreover, at this stage it is already necessary to include in the program the types of material resources which are scarce in the national economy and which are consumed by construction in relatively large amounts. There should be assigned to them the products of ferrous metallurgy, the timber and wood processing industry. We conventionally call these resources especially limited ones. As to the remaining types of resources which are used in the process of producing construction materials, structures, parts and of construction itself, their supply at the first stages can be established indirectly on the basis of the determination of the mentioned aggregated resources. In order to distribute the resources among the individual works within the complex the apparatus of the intersectorial or interproduct balance should be used. It can be used especially successfully for the balanced distribution of products, the consumption of which is limited to the construction block.[7]

It is necessary to note another peculiarity of construction, which considerably complicates the planning of its interrelations both within the construction complex and with the economic environment outside it. The demands

of the sectors of the national economy on construction are embodied in physical indicators, production capacities or the physical amounts of construction products (the cubic volume of buildings, the floor space of housing, the length of roads and so on). At the same time a cost indicator--the estimated cost of the construction and installation operations--serves as a measurer of the production volumes of construction and the capacities of construction organizations.

Owing to the diversity of the physical and material form of the construction product and its objects the estimated cost of construction and installation operations is the only possible general indicator of the planning and management of the sector. The planning of construction, the evaluation of the activity of the latter and the supply of resources are accomplished on its basis. Therefore in national economic programs, in which construction is a direct or indirect participant, there should be formulated precise requirements in the form of the designation of the physical and material composition of the end result, which should also receive an adequate evaluation in the general indicators adopted in construction. For example, when drafting a program of the increase of the level of the provision of housing and municipal and everyday structures the requirements can be expressed in the form of a set of quantitative and qualitative parameters: the floor space of housing, the types of apartments and so on with enumerations of the corresponding qualitative characteristics dictated by social standards. The requirements should be advanced with approximately the same degree of concentration when drafting other national economic programs in which the place of an indirect participant is assigned to construction. It seems to us that the lack in comprehensive scientific and technical programs of specific assignments in physical and material form has complicated their fulfillment for construction as a participant.

In conformity with the content of the programs and the specific nature of the sector it is necessary also to determine the criteria for evaluating the choice of alternate solutions at different levels. Here the adjusted expenditures should be regarded as one of the possible criteria. With allowance for the specific nature of construction for the choice of alternatives when elaborating a system of measures at the upper level of the sector it is possible to recommend the following criteria: 1) the maximum satisfaction of the goal indicators (requirements) of the programs external with respect to construction, or the goal indicators of the sectorial programs in the case of set restrictions: the estimated cost of construction and installation operations, the periods of construction, the consumption of universal and especially limited resources; 2) the maximum amount of introduction of fixed capital in value terms in the case of set restrictions: the goal indicators (requirements) of programs external with respect to construction, or goal indicators of the sectorial programs, the periods of construction, the consumption of universal and especially limited resources, the estimated cost of construction and installation operations; 3) the minimum period of construction in the case of set restrictions of the goal indicators (requirements) of the programs external with respect to construction, or the goal indicators of the sectorial programs, the consumption of

universal or especially limited resources, the estimated cost of construction and installation operations.

At lower levels of the tree of goals of the external or sectorial programs, when choosing alternatives the following criteria can be used with allowance for various restrictions: the maximum production volume of the products of construction or of other sectors directly connected with it; the minimum level of current production costs of the products of construction or of other sectors directly connected with it; the minimum level of national economic expenditures with allowance for the operation of ready projects; the minimum consumption of various resources. The proposed list of criteria does not claim to be complete. The diversity and complexity of the program tasks in the process of drafting the programs can cause the adoption of other criteria as well. However, it is obvious that, no matter at what levels the criteria are applied, they should have a general direction. The making of decisions in conformity with these criteria should not contradict the content of the goals of the upper level and, consequently, complicate the implementation of the programs.

In connection with the fact that the program-goal approach is called upon to reflect the indicators of the project, which characterize the various aspects of development in the necessary and most effective direction, it is expedient for solving global problems to single out several blocks which cover individual sections of the problem: scientific and technical, design, production, economic and social. Each specific block represents a separate aspect of the overall tree of goals and includes several levels.

The main goals of the indicated blocks appear with respect to the entire system as goals of a second order, but then the next levels of the goals, tasks and measures are formulated. In the formation of any construction program in the design block there can be set as one of the main goals the goal with the following content--"The Improvement of the Volume-Layout Solutions of Buildings and Structures," in the production block--"The Improvement of the Technology of Construction, the Extension of Complete Mechanization and Automation." In turn, the latter can be broken down into tasks of a smaller scale, such as "The Elaboration and Introduction of Efficient Methods of Performing Excavation and Earth Moving," "The Introduction of Efficient Methods of Working Permafrost Soils" and so on.

One of the main goals of the economic block can be expressed in the following manner--"Assurance of the Fulfillment of the Set Tasks Without the Additional Involvement of Manpower" or "The Reduction of the Materials-Output Ratio of Construction and Installation Operations" and others. The setting of the goals and tasks and the implementation of the measures of each block should be done in conformity with a single idea. The formation of the blocks and their division into basic and auxiliary blocks are determined by the class and type of programs. The structure of each of the blocks might also not coincide with the structure of the overall tree of goals, since each section constituting the content of the block has its own

independent tasks. However, the goals of the blocks should be coordinated and subordinate to the main goal.

At the lowest level of the tree of goals of each block the measures making it possible to formulate the resource programs are indicated. At the initial stages of the drafting of the program the demand of the entire system for resources will be specified in the form of an order to other sectors as the sum of the demands of the individual blocks. This approach in the first iterations is inevitable, although it does not always make it possible to detect the synergistic ties and to take into account the economy caused by them. Of course, the constructed model of the tree of goals in the context of the separately taken block is not identical to economic processes--the affiliation of the tasks being solved with certain blocks or others is arbitrary. In reality the goals of the blocks, the tasks and especially the measures will intersect. For example, it is difficult to determine, to which block (scientific and technical, design, production, social or economic) the solution of such a problem as the improvement of the system of the organization and management of a sector belongs.

Goal programs, which are devoted to special problems of a smaller scale, at the sector level can be implemented with less success. In this instance the problem of resource supply is sharply aggravated. Additional complications arise which are connected with the allocation of resources for the realization of the given goal on the scale of the sector, since the order of the program for resources, given the planning mechanism in effect, might be lost in the overall plan of the sector.

Among the questions requiring further elaboration are: the forms of the program assignments for sectors, the methods of transforming these assignments into a sectorial plan, the means of distributing resources between program and nonprogram products, the determination of the group of resources being distributed in connection with the programs and the extent of their disaggregation, the coordination of criteria, as well as of the indicators of the evaluation of the activity of the sectors with the requirements of program-goal planning.

Along with this the need has arisen to solve practical questions of the introduction of the program-goal approach in the sectors of the national economy and industry. Among these questions are the status of the program in the sector, the procedure of coordinating the various processes of planning and financing, the methods of monitoring and controlling the implementation of programs. The solution of these questions will make it possible to use the program-goal method more extensively in planning, as was stipulated by the 25th CPSU Congress.

FOOTNOTES

1. See "Kompleksnoye narodnokhozyaystvennoye planirovaniye. Postanovka problemy i podkhod k yeye resheniyu" /Comprehensive National Economic

Planning. A Statement of the Problem and an Approach to Its Solution/, edited by N. P. Fedorenko, Izdatel'stvo "Ekonomika", 1974; B. A. Rayzberg, Ye. P. Golubkov, L. S. Pekarskiy, "Sistemnyy podkhod v perspektivnom planirovanii" /The Systems Approach in Long-Range Planning/, Izdatel'stvo "Ekonomika", 1975.

2. See V. Disson, "The Use of the Program-Goal Method in Solving Scientific and Technical Problems" (PLANOVOYE KHOZYAYSTVO, No 7, 1977, pp 79-80).

3. Recently an interesting attempt was made to develop a formal apparatus for evaluating the closeness of the ties for the purpose of forming complexes (see, for example, A. R. Leybkind, V. F. Presnyakov and B. L. Rudnik, "On the Question of Distinguishing Blocks of Comprehensive Intersectorial Planning," EKONOMIKA I MATEMATICHESKIYE METODY, Vol XIII, No 5, 1977).

4. In our opinion, M. Lemeshev and A. Panchenko define the content of the complex imprecisely. On the one hand, the authors regard complexes as production units which unite a number of sectors which are interconnected technologically and functionally (such complexes are based on a unity of production interests, which are relatively stable in time), on the other hand, complexes, in their opinion, are a group of sectors, the activity of which is aimed at the accomplishment of specific socio-economic goals of the national economy. In this interpretation a goal-setting principle is placed at the basis, in connection with which the integral connection between the sectors is not included in the obligatory conditions. The multiaspect nature of the goals facing the national economy and the difference in time of their accomplishment predetermine, therefore, the constant mobility of such complexes (see M. Ya. Lemeshev, A. I. Panchenko, "Kompleksnyye programmy v planirovanii narodnogo khozyaystva" /Comprehensive Programs in National Economic Planning/, Izdatel'stvo "Ekonomika", 1973).

5. See I. G. Popov, A. G. Fonotov, "On the Coordination of the Resource and Goal Aspects in Long-Range Planning," "Programmno-tselevyye metody v planirovanii. Tezisy dokladov Vsesoyuznoy konferentsii 'Programmno-tselevyye metody v planirovanii i upravlenii v svete resheniy XXV s"yezda KPSS'" /Program-Goal Methods in Planning. Heads of Reports of the All-Union Conference "Program-Goal Methods in Planning and Management in Light of the Decisions of the 25th CPSU Congress"/, Central Institute of Economic Mathematics of the USSR Academy of Sciences, Scientific Research Institute of Economics of USSR Gosplan, VNIISI of the State Committee for Science and Technology of the USSR Council of Ministers and the USSR Academy of Sciences, 1977, pp 168-177; V. I. Kagarlitskaya, "The Modeling of the Distribution of Capital Investments in a Long-Range Program," "Programmno-tselevyye metody v planirovanii. Tezisy dokladov Vsesoyuznoy konferentsii 'Programmno-tselevyye metody v planirovanii i upravlenii v svete resheniy XXV s"yezda KPSS'," pp 178-183.

6. See Ye. I. Andreyeva, A. A. Bernshteyn, Ye. V. Levner, T. V. Ukhanova, "A Model of the Distribution of Resources in Comprehensive Goal Programs. A Method and the Experience of Drafting National Economic Programs," "Tezisy

dokladov Vsesoyuznoy konferentsii 'Programmno-tselevyye metody v planirovanii i upravlenii v svete resheniy XXV s"yezda KPSS'," pp 20-28.

7. The problems of forming the construction complex and the intersectorial ties of construction were covered by D. Chudnovskiy, I. Shapiro and S. Baranova (see "Methodological Problems of Planning an Intersectorial Construction Complex," PLANOVOYE KHOZYAYSTVO, No 2, 1976).

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INDUSTRIAL PRODUCTION STRUCTURE

Moscow VOPROSY EKONOMIKI in Russian No 12, Dec 78 pp 34-43

/Article by R. Livshits: "The Efficiency of the Production Structure of Industry"/

/Text/ The structure of industry and of the entire national economy includes three elements: the correlation between subsectors and sectors within the entire national economy (the sectorial structure); the territorial proportions within individual sectors and subsectors, economic regions, territorial production complexes (the disposition of physical production and the nonproductive sphere); the correlation between enterprises of different compositions and production capacity, which is determined by the development of concentration, specialization, cooperation and combination.[1]

When studying the efficiency of the structure of the national economy and industry the question arises, to what extent are these elements interconnected and is the effective development of each of them governed by factors which are common for all of them or are inherent only to it. The sectorial and subsectorial structure of the national economy is the basis of its territorial and production structure, since the importance of each of the factors of the increase of the productivity of national labor and production efficiency differs depending on its sectorial structure.

For example, for the economy of agriculture, the mining industry and the so-called raw material sectors of industry (that is, the sectors in which the main place in the expenditures on production belongs to raw materials and materials) the natural conditions of the production and extraction of the raw materials and materials play an important role, for the sectors of the processing industry, where the expenditures on materials are relatively small--the resources and skills of labor.

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1. We call this correlation the production structure, which to a certain extent is arbitrary, since the sectorial structure of industry and of the entire national economy in the sphere of physical production could be grouped with the production structure.

At the same time each sector, depending on its technological peculiarities, is characterized by a different type of the most efficient territorial disposition and by the difference of the optimum compositions and sizes of the production capacity of enterprises. Thus, the development of production specialization is of enormous importance for the effective development of the sectors, the finished product of which is the result of the assembly of individual components and parts (machine building and others); for the sectors of the processing industry with the complete processing of raw materials and multistage production processes (the chemical industry, the petroleum refining industry, nonferrous metallurgy and others) in a number of cases the combination of individual works within one enterprise is effective. Therefore the different sectorial pattern of production is also connected with the difference of its production structure. At the same time all the processes of the social division of labor, which determine the production structure, are closely interconnected.

Any change of the composition and capacity of one enterprise of the sector affects the enterprises of both this and other sectors and the territorial complex as a whole. A decrease of the public expenditures on the production of a unit of a product does not always coincide with the decrease of the expenditures at the individual enterprise. Therefore the optimum, from the point of view of the entire national economy, compositions of the shops and the sizes of the production capacities of individual enterprises are ascertained most precisely during the optimization of the entire system, of which they are components. The optimum compositions and size of industrial enterprises are not simply a function of the long-range plans of development of the sectors and territorial production complexes. Their scientifically sound planning is necessary already when the long-range plans of the optimum development of individual seccors of industry or territorial production complexes are still lacking or are at the stage of drafting and when the composition and sizes of enterprises can be determined only approximately. In these instances the knowledge of the approximate parameters of the enterprises of the optimum compositions and size makes it possible to draft standard construction plans for their subsequent use during the immediate period being planned. This measure is conducive to the decrease of the duration and the reduction of the cost of the drafting of plans, as well as the duration of the construction.

The problem of determining the optimum production structure arises in the construction of new and the modernization and expansion of operating enterprises. Therefore, we take as the indicator of its efficiency the formulas of the adjusted expenditures, which are recommended by the Standard Method of Determining the Effectiveness of Capital Investments,[2] the calculation

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2. $K + T_H C = \min$ or $C + E_H K = \min$, where K is the capital investments according to each variant, rubles; T_H is the sectorial standard term of recovery, years; C is the production cost of products for a year according to the same variant, rubles; E_H is the sectorial standard coefficient of efficiency.

of which should be made more precise in conformity with the peculiarities of the problem in question. In particular, in determining the optimum production structure it is necessary to take into account: transportation costs, which increase with the consolidation of enterprises; the losses which occur in some sectors of industry with an increase of the periods of the delivery of raw materials and finished products, as well as with their storage; the additional expenditures which arise at times as a result of the pollution of the atmosphere, the worsening of the conditions of water supply, the complication of supply lines; the difference of the periods of the construction and placement into operation of enterprises of different compositions and sizes; the increase of the population density, especially when concentrating at one point two or three major enterprises; the complexity of production management at especially large enterprises.

With allowance for the indicated circumstances the formulas of the adjusted expenditures when determining the optimum production structure change slightly:

$$K + T_H C_H + \Pi_1 + \Pi_2 = \min,$$
$$C_\Pi + E_H K + \Pi_1 + \Pi_2 = \min,$$

where C_Π is the total expenditures on the payment for the delivery and processing of raw materials, fuel, semimanufactures, which ensure the output of the finished product and its shipment to the regions (centers) of consumption; Π_1 and Π_2 are all the types of losses and additional expenses, which arise with different variants of the production structure (particularly with different levels of concentration). The minimum expenditures are determined on the basis of the national economic efficiency. Here the consideration of the lag (the gap in time) between the making of capital investments and the received yield is important. The lag may differ in the construction of enterprises of different compositions and capacity and it should be calculated by the method of adjusting the capital expenditures to a single moment of time.

The same thing pertains to the production cost of the product, if there are substantial differences in the periods of the placement into operation and achievement of the planned indicators with different variants of the production structure. In all instances it is important to take into account the associated capital investments of those sectors, the products of which take up a significant proportion in the production cost of the products of the enterprise in question, otherwise the calculation is unduly complicated. In conformity with the specific peculiarities of the individual sectors the expenditures on the delivery of finished products to consumers might not be taken into account in the sectors, the finished products of which constitute only a small part of the raw materials expended on their production; in the sectors where the weight of the finished product exceeds the weight of the raw materials expended on its production (the sulfuric acid, baking, confectionary sectors of industry and others), the calculation of only the expenditures on the delivery of the finished product to the consumers is necessary. In industry there are sectors which produce products which are

small in weight, but which have a great value. In such sectors the proportion of the transportation expenses is relatively small and it is possible to decline to calculate them.

The optimum production structure of individual sectors is determined not only by general, but also by specific factors. A number of sectors are characterized by a similarity of these specific factors. Among these sectors are: the mining industry, in which with the concentration of production there take place a decrease of the term of service of enterprises, an increase of the amortization deductions and expenditures on mine preparations, which fall to the annual output of products; electric power and the so-called one-product sectors of the processing industry, which produce relatively uniform products (cast iron, steel, many products of the food industry, products of the textile industry and others); the processing industry, which produces complicated diverse products consisting of numerous partial products--intermediate products, parts, assemblies and others (the so-called multiproduct sectors--machine building, some sectors of light industry--leather shoe, sewing sectors); the processing industry with the complete processing of raw materials and multistage production processes (the chemical industry, nonferrous metallurgy and others).

The proposed method of calculating the efficiency of the production structure pertains only to products which are comparable directly or as a result of their reduction to a comparable type. In the extractive and one-product sectors the optimum production structure is confined mainly to the optimization of the capacities and sizes of the works at the enterprises being designed or modernized. At the same time in the multiproduct sectors and sectors with the complete processing of raw materials this problem is combined also with the establishment of the optimum set of shops for each enterprise, that is, with the calculation of the comparative economic efficiency of the combination of a number of works and services within one enterprise or the making out of them of independent specialized enterprises of the optimum sizes.

In the extractive and raw material sectors the concentration of production is effective to the extent to which it corresponds to the available raw material resources for their development. In all other sectors concentration according to the overall sizes of the works and the number of workers at the enterprises is effective only when the composition of the latter is properly determined or when there is an effective combination of production and services. Such a combination always increases the concentration of production. The situation is different with specialization, which, as a rule, involves the increase of the sizes or the concentration of some uniform production, but might at times lead to the creation of enterprises which are relatively small according to the production capacity and the number of workers. Such enterprises should be organized in all those instances when their optimality from the national economic standpoint has been established.

In this case the efficiency of the combination at an enterprise of successive stages of the processing of raw materials is determined by the economy of the production cost and the capital expenditures, which is obtained for each conversion included in a single technological cycle as compared with making it into specialized enterprises. The economy obtained as a result of the complete use of raw materials is calculated by adding up the economy for individual technological factors (the improvement of the level and degree of the complete use of raw materials, the improvement of the technology at associated enterprises and sectors and others). Without giving in further detail the method of the calculations of the optimum production structure in different sectors, let us dwell on the examination of general questions which are of great importance for these calculations.

The minimum adjusted expenditures on the production of products at the places of their consumption function as a criterion of the efficiency of the production structure with new construction and the technical modernization of operating enterprises. However, it is necessary to make substantial changes in the calculation of the production cost and the capital expenditures, so that the indicators of the efficiency of the production structure would become more reliable. In the evaluation of the efficiency of the work of operating enterprises and the existing production structure the capital investments take the form of their already realized part--the functioning and used fixed and working capital and the achieved labor productivity. Therefore, the indicators of the recovery of the capital investments and the adjusted expenditures can be replaced by the social production costs or the production cost of the product, which embody all the expenditures of living and embodied labor. The indicator of the social production costs or the production cost of the product, being the monetary expression of these expenditures, should be supplemented by an analysis of the other (in a number of sectors physical) indicators determining it, particularly the indicators of the amount (norms) of the expenditures of raw materials, fuel, materials and semimanufactures per unit of production, the indicators of the productivity, organization and power-output ratio of living labor, the data which characterize the extensive and intensive use of the fixed production capital and others.

The comparison of the efficiency of the production structure at operating enterprises can be made only by reducing the composition (set) of their shops and the assortment of production to a comparable type. If an enterprise produces several different types of products, its production structure is defined as the sum of the production capacities which are calculated separately for all types of products. The production cost is calculated in precisely the same way both for all the products as a whole and separately for the component works.

The comparison of the total production cost of products when calculating the optimum production structure in all cases is limited to operating enterprises or enterprises being built, for which purchased materials, semimanufactures and components have an identical proportion in the production cost

of the products. When comparing enterprises with various shops the production cost of the products can be calculated only on the basis of the inclusion in it also of the production cost of the products being produced by the supplier shops. Of course, the structure of the products being produced (their variety, the labor-intensiveness of production and the quality) should be the same.

The evaluation of the production efficiency and the existing production structure of operating enterprises on the condition of the reduction of their composition to a comparable form and with consideration of the differences of the technical level of production can be made according to the formula C:P = min, where C is the production cost of a unit of products, which includes c or the expenditures of past labor (along with the amortization deductions), v is all the types of expenditures on wages with the set contributions to the state budget to finance social insurance benefits; P is the size of the works, here both C and P should be taken on a specific annual scale. This formula of the calculation of the efficiency of production and the production structure has a very simple form. In reality its use involves great changes and specifications of the existing methods of determining the production cost of products, such changes which would bring this important indicator of production efficiency closer to the real expenditures of national labor. These changes should also be made when calculating the adjusted expenditures under the conditions of new construction.

At present the dynamics of the production cost and the cost which expresses the expenditures of socially necessary labor might not coincide, which is connected with the used methods of the accounting and calculation of the production cost. The cost of the means of production, which are consumed in the production process and are a decisive part of all expenditures on the production of products in the USSR, when calculating the production cost is calculated for raw materials, fuel, materials and semimanufactures on the basis of the wholesale factory prices and the transportation rates, which may be higher, but sometimes also lower than the actual cost of these materials and their shipment to the consumers. In the production cost the consumed fixed capital is represented by the standard amortization deductions. These deductions in a number of sectors for many years did not reflect the actual depreciation of the fixed capital and thereby their value, which was transferred to the newly created product. Finally, the wage reflected the social expenditures on payment for the necessary labor, but not the value itself of the necessary product.

The dynamics of the production cost does not always reflect the changes in the production process. The production cost is also influenced by nonproduction factors (a change in prices, rates, the regulation of wages and others), which are not connected with changes in the labor process. The increase of labor productivity, which causes a decrease of the cost, also might not be reflected in a decrease of the production cost, if the increase of wages outstrips the increase of labor productivity. At the same time an increase of wages, without changing the value of goods, under certain

conditions involves an increase of the production cost. At the same time there are also taken into account in the production cost various expenditures on the management and maintenance of production, among which there are also expenditures of a nonproductive nature (the payment of fines, penalties and forfeits, shortages and flaws of products). The latter, in essence, are only a deduction from the value created in the production process.

In spite of the noted shortcomings, the production cost serves as the most important indicator of the socially necessary expenditures of labor, the efficiency of production and the production structure, since it is the only indicator of the expenditures not only of living, but also of embodied labor, the value of which is great especially as the physical accounting of the total labor expenditures on the production and transportation of products at present is still at the stage of experimental operations and calculations. Therefore the labor expenditures in practice can be calculated only in monetary form. It is a matter not of the replacement of this indicator of the efficiency of production and capital expenditures, which truly exists and is used in USSR economic practice, by some other one, but of that improvement of its calculation, in case of which it would be a reliable measurer of the total labor expenditures on production, transportation and construction.

The drawback of the production cost is that it is a price category and the bulk of the embodied labor (the expenditures on raw materials, fuel, power, basic and auxiliary materials, which constitute in the production cost of industrial products about 75 percent of all the expenditures on production) in it is presented in wholesale factory prices, which at times differ substantially from their actual (real) production cost. Here the principles of pricing even in groups of related sectors are not always the same.

With the planned management of the economy the distorting influence of prices on the actual production cost of products can be eliminated. For this there is needed the calculation of the real national economic production cost of products in parallel with the price calculation, in which the raw materials, fuel and materials used for the production of the products would be calculated according to the actual (or planned, if it is a matter of [illegible] capital construction) production cost. Such a calculation is quite possible, taking into account the high level of concentration in the national economy, as well as the fact that in the most important sectors and sectorial complexes the production cost is formed successively. In this case in the sectors of the mining industry and in agriculture, where the expenditures on raw materials and basic materials are absent, the production cost of products even in their price calculation is close to the real national economic costs, for it is determined above all by the expenditures of the necessary labor and the amounts of the wages paid. Meanwhile mineral fuel, mineral and agricultural raw materials remain for the present the decisive base, on which the national economic costs and the production cost of products are formed.

The planning system of the economy makes it possible to regard the entire production process and the expenditures of labor at its different stages as a single whole. With the different structure of the expenditures on production in individual subsectors the total expenditures for each of the sectors of the national economy should reflect the actual social expenditures on the payment for living or expended embodied labor (capitalist costs are measured only by the expenditures of labor at the given enterprise or in the given association of enterprises--the concern, the trust and others). This is possible, for the production cost of products, as was already noted, is formed successively--along "chains" of interconnected works. Therefore, in accordance with the expenditures of embodied labor the production cost at each subsequent stage of processing should reflect the real expenditures of the preceding production cycles.

What has been said can be illustrated by the example of the metal industry (machine building, ferrous and nonferrous metallurgy with their raw material and fuel bases). The formation of the final product of the metal industry begins with the mining of coal for coking and ore. The expenditures on coal are 85-90 percent of the production cost of the coke, while the expenditures on coke and iron ore are approximately 90 percent of the total production cost of pig iron, which basically determines the production cost of steel and rolled products. Thus, the real national economic production cost of ferrous metal can be calculated on the basis of the data about the actual production cost of the raw materials, on which its production is based. These calculations are facilitated by the high level of concentration of production in ferrous metallurgy (17 plants yield about 80 percent of all the steel smelted in the country), by the territorial concentration and small number of the raw material and fuel deposits being used.

As is known, ferrous metal is the main construction material of the final product of the metal industry, which is produced by machine building and metalworking. In these sectors the expenditures on materials and semimanufactures, which consist mainly of ferrous metal, constitute approximately 60 percent. Thus, here the accounting of materials according to the real cost of their production is quite feasible when there is the precise registration of the sources of their receipt by the consuming enterprises.

Under the conditions of a socialist economy the expenditures of labor and the production cost can be examined not only within the individual enterprises, but also at all enterprises and sectors, including interconnected ones. Therefore, along with the calculation of the national economic production costs of products it is also necessary to draw up for sectors and subsectors planning and accounting balances, which are differentiated by enterprises, oblasts, economic regions and republics, of the rates of consumption of fuel, electric power, raw materials and materials per unit of production. Along with the increase of the physical indicators the reduction of the elements, which are included in the production cost, of the marketing costs (expenditures connected with the sale of the product and others) and administrative and operating costs serves as a source of accumulation.

The standardization of the costing of products and its calculation by elements of the expenditures are an obligatory prerequisite of the calculation of the real national economic expenditures and the measurement by them of production efficiency. At present the methodology of calculating the production cost is different in different sectors. In some it is calculated according to the elements of the expenditures, in ot ers within the production cost there are so-called complex items (shop costs and others), which include both material expenditures and expenditures on wages. In a number of sectors the proportion of these complex items in the production cost is very high. For example, in machine building its reaches at times 40 percent of the total production cost. The determination of the actual national economic production costs presumes the standardization of the methods of their calculation in all sectors according to the elements of the expenditures.

On the level of the individual enterprises the indicator of the production cost of products can be supplemented by the indicator of the cost of the processing of these products, in case of which only the amounts of the expenditures of the enterprises on the processing of purchased raw materials, fuel, materials and semimanufactures would function as a criterion of production efficiency, while the cost of the latter would be excluded. Under the conditions of the price calculation of the expenditures on purchased raw materials and materials the indicator of the cost of processing the products characterizes the efficiency of the production structure and the operation of individual enterprises better than the production cost of these products as a whole. However, when calculating the real national economic production cost of products the advantages of the indicator of the cost of processing disappear, for the production cost itself becomes a reliable indicator of the social expenditures.

It should be noted that when determining the optimum production structure under the conditions of new construction not only the calculation of the production cost, but also the second component of the adjusted expenditures--one-time capital investments--should be adjusted. Like the production cost, the capital investments should be calculated according to their real national economic importance. Thus, when there is a substantial difference between the zone wholesale prices and actual production cost of construction materials, it is necessary to evaluate the latter according to the cost of their production.

When calculating the capital investments, as when calculating the production cost, all the transportation expenditures on the delivery of raw materials, fuel and materials and on the shipment of finished products to consumers should be determined with allowance for the actual distance and cost of carriage and the capital investments in the development of the transportation network. In some sectors the transportation costs, which are represented in the form of the average values for the entire country, are included in the wholesale prices for purchased raw materials, materials and semimanufactures. The prices for some very important materials are the

same and do not reflect the regional differences of the production cost. Finally, the zone prices for products and raw materials, which are in effect in a number of sectors (for example, in the sugar industry), distort the comparable evaluations of enterprises of different capacity. Therefore, the calculation of the production cost of products at the places of consumption, it seems to us, should be made according to the formula:

$$C_n = (C - T) + (T_1 + T_2)$$

where C_n is the adjusted real national economic production cost of a unit of products in the region (place) of consumption; C is the adjusted production cost of these products in the region (place) of production; T is the actually paid transportation costs for the delivery of basic raw materials, fuel, materials and semimanufactures, including the transportation expenditures included in the wholesale prices of raw materials, fuel, materials and others; T_1 is the transportation costs for the delivery of raw materials, fuel, materials and semimanufactures, which are calculated according to the production cost depending on the actual distance of carriage; T_2 is the transportation costs for the delivery of finished products, which are calculated according to the production cost depending on the actual distance of carriage.

The problem of calculating the real national economic expenditures is most important when estimating the efficiency of the existing production structure, as well as when establishing the efficiency of the capital expenditures on its creation. Another problem is: what indicator is suited to the greatest extent for the estimation of the sizes of a works at enterprises, in individual sectors and subsectors and in the national economy as a whole? We assume that the sizes of an enterprise in one-product sectors (that is, in sectors with the mass output of some one product), as well as at individual works of sectors, which produce various types of products with a uniform combination, can be measured in physical terms. Thus, the size of enterprises in the extractive sectors, in the construction materials industry, in electric power engineering, ferrous and nonferrous metallurgy, in founding and forging and so on is best characterized by the number of products produced by them over a specific period of time. Of course, in one-product sectors the physical indicators of the output of products, particularly when establishing the efficiency of the production structure of individual enterprises, are subject to correction. This is connected with the fact that, first, the same products have in a number of sectors different indicators of labor-intensiveness of their production and quality. In this case the calculation of the sizes of enterprises or individual works needs to be made on the basis of a conversion according to coefficients of equivalency in conventional units.[3] Second, in some sectors the output of

3. For example, the size of a works for boilers should be measured by their total output and productivity in thousands of tons of steam per hour; turbines and generators--according to the number and amount of output of the turbines and generators in thousands of kW; motor vehicles and tractors in conventional physical units--according to the total carrying capacity and

products differs depending on the assortment. In such sectors it is better to determine the size of enterprises according to the amount of installed similar equipment. Third, in the sectors processing agricultural raw materials, the receipt of which is of a seasonal nature, the size of the enterprise is determined by the amount of raw material processed in a day.

However, there are few one-product sectors. The majority of sectors produce various types of products. Therefore, the calculation of the total production can be made only in value form--as the gross or commodity production of the individual sectors of physical production and the gross national product on the scale of the entire national economy or as the net production (or value added) of individual sectors and the national income.

The drawbacks of the indicator of the gross (and commodity) production as an indicator of the sizes of a works are well known. Therefore, a number of industrial enterprises, when determining the size of the works, also use the indicator of the processing cost, which is calculated as the difference between the cost of the output of the gross production over a specific period of time and the expenditures on purchased materials, semimanufactures, fuel and electric power. The processing cost (or the value added) is formed from the basic and additional wages with deductions for social insurance, various deductions (for the creation of the bonus fund for the introduction of new equipment, for scientific research), amortization deductions from the value of the fixed production capital, expenditures on the maintenance of equipment and the surplus product (the profit). The indicator of the processing cost or the value added during processing is used to characterize the sizes of a works at enterprises and in individual sectors in the statistics of all industrially developed countries. This indicator reflects the sizes of works more precisely than the indicator of the gross or commodity production, although it is not free from the influence of prices, which affect it through the subtracted value of the materials and semimanufactures used in the production process. The differences in the wage rates and the profit by sectors and works also have an effect.

In the calculation of the cost of raw materials, fuel, materials and transportation rates according to their actual national economic production cost the influence of the price factor is basically eliminated. There remain the assortment differences in the amounts of the profit, which can be eliminated by introducing an average profit, which is uniform for the enterprises of on sector or another and is independent of the assortment (this has already been done at the enterprises of the Ministry of the Shipbuilding Industry). There are no ideal value indicators. Therefore it is necessary to choose

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3. (continued) horsepower; casting--in conventional tons; excavators--in cubic meters of capacity. In ferrous metallurgy the smelting of steel is the most reliable indicator of the sizes of enterprises under the conditions of uniform combination, since the product mix of rolled products at the plants and the labor-intensiveness of the production of their various types differ substantially.

the most reliable ones, as far as possible adjusting them by physical indicators. In our opinion, the net production, which reflects all the expenditures of living labor, is the most precise value indicator of the sizes of a works. In this case it is necessary to exclude from the net production all the nonproductive expenditures (the payment of fines, penalties and forfeits--usually they remain in it), and with respect to enterprises to take into account the fact that the amounts of the net production should be adjusted by the indicators of the power-worker ratio. Otherwise the small, poorly mechanized enterprise will have advantages over the well-mechanized large enterprise.

Thus, in the specific calculation of production efficiency on the national economic scale in the numerator there will be the national income, while in the denominator there will be the expenditures which form the social production costs and are taken into account in the production cost of products (material expenditures, including in them the amortization deductions, and the paid wages in all their forms with deductions for social insurance benefits). The efficiency of capital investments, it seems to us, should be established at the stages of the planning of new construction or the technical modernization of enterprises. When measuring the efficiency of production and the production structure at operating enterprises, the capital investments are taken into account in the production cost as amortization deductions.

Let us cite a real calculation of production efficiency in conformity with the method of its calculation, which we have adopted (the materials expenditures are presented not according to the actual national economic production cost, the calculations of which are not presently being made, but according to the current wholesale factory prices).

According to the data of the intersectorial balance, in 1972 56.3 percent of the gross product fell to material production expenditures, 22 percent--to wages and other forms of pay and 21.7 percent--to the surplus product of society. The gross national product in 1972 was equal to 717.4 billion rubles. Thus, the material expenditures were 403.9 billion rubles, wages and other forms of pay--157.8 billion rubles, while the coefficient of efficiency, that is, the ratio of the expenditures to the net production (the produced national income, which in 1972 was equal to 313.2 billion rubles)--1.79. The calculation will be more precise when calculating the national economic costs according to their actual production cost. The amortization deductions, as was noted above, are the standard ones and do not always reflect the actual depreciation of the fixed capital. However, their proportion in the social production costs is small (about 5 percent) and they cannot change the results of the calculation of the economic efficiency of production.

The need to specify the minimum expenditures when calculating the efficiency of the production structure, in our opinion, is determined by the presence in the production cost of products and the capital expenditures of

conditionally permanent and not entirely proportionate expenditures which, as planning practice shows, decrease with the concentration of production. In a number of instances they reach their minimum with sizes of a works, which exceed the total national economic demand for one product or another for the planned period of time. In this case, beginning with a specific (high) level of concentration, the production cost decreases negligibly, the relative increase of the capacity entails almost the same relative increase of the capital expenditures.

As has already been indicated in economic literature, even at the level of intraworks expenditures concentration and specialization in planning are the optimum when the increase of the capacity with respect to the preceding value on the dimensional level outstrips the increase of capital investments and when the production cost decreases sharply. What has been said pertains to intraworks efficiency. The consideration of all the conditions limiting the consolidation of production and the factors not yielding to quantitative measurement is also necessary.

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METHODOLOGY OF DETERMINING IMPACT OF NEW TECHNOLOGY

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[Article by V. Fel'zenbaum, a review of material received by the editors]

[Text] The new "Methods (Basic Provisions) of Determining the Economic Effectiveness of Using New Equipment, Inventions and Efficiency Proposals in the National Economy"[1] are mandatory for all branches of the national economy and serve as the basis for developing and approving branch methods instructions. As of now, the ministries and departments have worked out and approved, with the concurrence of the USSR Council of Ministers State Committee for Science and Technology, 37 branch methods instructions in developing the indicated "Methods."[2] Issuance of the "Methods" and branch instructions containing a number of new provisions has elicited comments, questions and suggestions aimed at further perfecting the methods of determining the economic impact of new equipment from scientific and practical workers. During the somewhat less than two years since the issuance of the "Methods," a certain amount of practical experience in their use has been accumulated in scientific-research and planning institutes and at enterprises and associations.

The editors think that familiarizing the readers with materials sent the journal will facilitate further improvement in the methodology of economic calculations. This will in the end be reflected in the official methods materials which will be developed as a result. Below is a review of reader letters and observations.

/Ya. Rips/ and /B. Savel'yev/ (Moscow, VNIIelektroprivod [All-Union Scientific Research, Planning and Design Institute for Automatic Electric Drive in Industry, Agriculture and Transportation]) include among the merits of the new "Methods," as compared with those previously in effect, the fact that in them, the economic impact of new equipment of long-term application is determined as its annual production throughout its service life with regard to a time factor. The time factor is considered by referring one-time expenses and overheads (impact) to a single instant of time, the adjustment normative E, equal to 0.1, differing from the normative effectiveness factor E_n, equal to 0.15, which is the same for all branches of the national economy and industry.

/V. Markelov/ (Khar'kov Institute of Automobile Roads) notes that use of the new method provides an opportunity for evaluating the economic impact of measures to improve the quality of the vehicles being produced. The production of improved equipment frequently requires additional expenditures of live labor, materials and capital investments, which lowers the economic indicators of enterprise operation. At the same time, the release of such equipment provides a significant impact in the area in which it is used, and that leads in the end to national income growth.

The national economic impact as calculated under the new "Methods" detects the results of improved product quality. In fact, formulas [4] and [5] of the "Methods,"[3] and especially point 16, which elucidates how to calculate the annual economic impact of an improved product, eliminate the previous artificial contradiction between product quality and the magnitude of the national economic impact.

As /V. Vybornov/ (Minsk, Belorussian State Institute of the National Economy imeni V. V. Kuybyshev) observes, the "Methods for Determining the Annual Economic Impact of New Equipment" which were approved in 1961 contained the erroneous recommendation that the impact of new equipment be determined as the algebraic total of the economic impacts of producing and using that equipment in stages, according to the formula:

$$\vartheta = (З_1 - З_2) + (З'_1 - З'_2), \qquad (1)$$

where $З_1$ and $З_2$ are reference expenditures in producing base and new tools of labor; $З'_1$ and $З'_2$ are reference expenditures in the operation of base and new tools of labor. The shortcoming of this calculation method is that expenditures on manufacturing base and new tools of labor are calculated repeatedly. In the first term of formula (1) they act as current expenditures on their manufacture, but in the second term (with the addition of normative profit), they act as capital investments on the acquisition of this equipment.

The bulk of the considerations contained in reader remarks and letters have been connected not with the known calculation methods available in preceding normative documents, but with methods approaches used for the first time in the "Methods": methods of calculating the long-term national economic impact of new means of labor, the relationship of national economic to cost-accounting impact for new equipment, and evaluating renovation deductions when determining national economic impact.

A number of observations were connected with point 13 of the "Methods," which gives the method for calculating the annual economic impact of producing and using new means of labor of long-term application (machinery, equipment, apparatus, and so forth) with improved qualitative characteristics (productivity, durability, operating outlays). It contains formula [4] for calculating "the annual economic impact of producing and using new means of labor of long-term application."

$$\Theta = \left[З_1 \cdot \frac{B_2}{B_1} \cdot \frac{P_1 + E_н}{P_2 + E_н} + \right.$$
$$\left. + \frac{(И'_1 - И'_2) - E_н (К'_2 - К'_1)}{P_2 + E_н} - З_2 \right] A_2, \qquad (2)$$

where $З_1$ and $З_2$ are reference expenditures per unit of base and new means of labor (in rubles), respectively; B_1 and B_2 are the annual amounts of product (work) produced using a unit of base and new means of labor (in physical units), respectively; P_1 and P_2 -- the proportions of deductions from the balance cost for full restoration (renovation) of base and new means of labor are calculated as reciprocals of the service life of the means of labor, with consideration of their obsolescence; $E_н$ is the normative coefficient of capital investment effectiveness (0.15); $И'_1$ and $И'_2$ are the consumer's annual overheads on using base and new means of labor, calculated per amount of product (work) produced using the new means of labor and excluding expenditures on their renovation (in rubles); $К'_1$ and $К'_2$ are the concomitant consumer capital investments (capital investments excluding the cost of the means of labor being examined) on using base and new means of labor, calculated per amount of product (work) produced using the new means of labor (in rubles); A_2 is the annual production of new means of labor in the calculation year (in physical units).

The authors note the terminological imprecision of using the word "annual" for the economic impact of producing and using new means of labor of long-term application (machinery, equipment, apparatus) as calculated using formula [4]. /L. Blank/ (Moscow, TsNIIOMTP [Central Scientific Research for the Organization and Mechanization of and for Technical Aid to Construction] of the USSR Gosstroy), /K. Velikanov/ (Leningrad Polytechnical Institute imeni M. I. Kalinin) and /V. Vybornov/ suggest calling it the impact of the annual release of new equipment for its entire service life, with consideration of obsolescence.

And, the authors add, the economic impact of using new technological processes, of production mechanization and automation, of new methods of organizing production and labor, is calculated under point 12 according to formula [3] as an annual impact, but the impact of creating new means of labor according to formula [4] is an impact over many years. What happens, then, is that the national economic impact of a new machine is several-fold higher for its manufacturer than for the plant using it to mechanize production.

A number of letters express doubts as to the correctness of calculating the national economic impact of producing and using new means of labor using formula [4] as the annual amount of new means of labor produced A_2. K. Velikanov and L. Blank think the amount of product (work) produced using new equipment in the year it is used, and not in the year it is manufactured, must be the basis for calculating the economic impact of any equipment.

L. Blank considers multi-year calculations of expenditures on and the results of individual measures on introducing new local-scale equipment unfeasible. In his opinion, the possible deviations in initial data values (including materials prices and services rates) when evaluating the impact of individual implements, objects and methods of labor, as distinct from calculating the impact of scientific-technical programs and other large projects, will lead to complete indeterminacy of the economic impact value, and the very task of choosing the best technical resolutions will be unfeasible.[4] Therefore, the economic impact over the service life of any implement of labor can turn out to be several dozen-fold or even hundred-fold higher than the impact obtained by the national economy. Moreover, when calculating the long-term impact, the very base of comparison becomes a variable. L. Blank notes that, under Point 10 of the "Methods," when solving the problem of introducing new equipment, "indicators of the best equipment designed in the USSR or foreign equipment which might be purchased in the necessary quantities" are used as the base. If the economic impact calculation is made in 1978, the letter notes, and the best equipment is used as the base (standard), in 1983, much less 1988, that equipment cannot be the best and cannot serve as a standard when determining the economic impact over the service life of the machine.

Many practical workers are interested in the thinking behind and the origin of formula [4] of the "Methods." The content of this formula was not revealed in the commentary by representatives of the "Methods" authors' collective or in the article by one of its authors, B. Zaytsev.[5] V. Vybornov attempted to derive the indicated formula. The annual national economic impact of new equipment when evaluated by sphere of consumption (ϑ), as is usually done, equals:

$$\vartheta = E_н (З_1 - З_2) + (C'_1 + C'_2), \tag{3}$$

where $З_1$ and $З_2$ are reference expenditures when manufacturing base and new implements of labor, $E_н$ is the normative capital investment effectiveness coefficient, C'_1 and C'_2 are current expenditures on operating base and new means of labor.

The "Methods" delineate that portion of current equipment operating expenditures which are designated for renovating means of labor. That value is determined as proportions of capital investments on the acquisition of means of labor (assuming equal reference expenditures on their manufacture) $P_1З_1$ and $P_2З_2$, respectively. If we now designate that portion of the consumer's operating expenditures remaining for renovation as $И'_1$ and $И'_2$, then expression (3) becomes:

$$\vartheta = З_1 (P_1 + E_н) - З_2 (P_2 + E_н) + (И'_1 - И'_2).$$

Dividing all the elements of this expression by $P_2 + E_н$, we obtain:

$$\vartheta = З_1 \frac{P_1 + E_н}{P_2 + E_н} + \frac{И'_1 - И'_2}{P_2 + E_н} - З_2. \tag{4}$$

where $\Theta = \frac{\bar{\Theta}}{P_2 + E_n}$

Formula [4] of the "Methods" is also obtained by adding three elements to expression (4): 1) the coefficient of change in the productivity of a unit of the new means of labor as compared with the base $\frac{B_2}{B_1}$ which, when multiplied by the first item of formula (4), ensures that the base variant will be made identical to the net result; 2) the difference in the value of concomitant equipment consumer capital investments, multiplied by the effectiveness normative $E_n(K'_2 - K'_1)$, which is added to the numerator of the second item, and 3) the value of the annual production of new means of labor A_2 in the calculation year; the entire specific impact from the introduction of one means of labor is multiplied by it.

V. Vybornov maintains that the sum of the renovation norm P and the effectiveness normative E_n does not lend itself easily to economic interpretation. Rather it is dictated by the convenience of the calculation, inasmuch as both these elements are expressed in the same units of measurement (proportions of capital investments). K. Velikanov, L. Blank, Ya. Rips and B. Savel'yev think the difference between $E_n = 0.15$ and $E = 0.10$, whose values are fixed in points 8 and 11 of the "Methods," is not taken into account in the derivation of formula [4] of the "Methods" and in calculating the renovation deductions for base and new equipment P_1 and P_2. Providing that, a different formula is derived than formula [4], obtained as a result of the transformations described by V. Vybornov.

Its deriviaion is provided by Ya. Rips and B. Savel'yev. They compare the base and new equipment variants with the corresponding indicators of productivity B_1 and B_2, service life T_1 and T_2, reference expenditures on manufacturing the equipment $З_1$ and $З_2$, annual consumer operating outlays (excluding renovation) $И'_1$ and $И'_2$, proportion of renovation deductions P_1 and P_2 and the concomitant consumer investments K'_1 and K'_2. According to formula (3), the national economic impact with consideration of making the variants identical to the net result in annual terms equals:

$$\bar{\Theta} = З'_1 \frac{B_2}{B_1} - З'_2, \tag{5}$$

where $\bar{\Theta}$ is the impact in annual terms and $З'_1$ and $З'_2$ are reference expenditures in the operating sphere.

The reference expenditures in the equipment operating sphere are shaped in accordance with the usual rule, which looks as follows in the accepted notation:

$$З'_1 = (И'_1 + P_1 З_1) + E_n (З_1 + K'_1), \tag{6}$$

and

$$З'_2 = (И'_2 + P_2 З_2) + E_n (З_2 + K'_2). \tag{7}$$

Hence, the national economic impact in annual terms, as calculated based on the difference in annual reference expenditures, is:

$$\dot{\vartheta} = \frac{B_2}{B_1}[(H'_1 + P_1 3_1) + E_н(3_1 + K'_1)] - [(H'_2 + P_2 3_2) + E_н(3_2 + K'_2)]. \quad (8)$$

When determining the national economic impact not for the year, which we have designated $\dot{\vartheta}$, but for the entire service life of new equipment T_2, designated ϑ in the "Methods," Ya. Rips and B. Savel'yev consider it necessary to divide expression $\dot{\vartheta}$ by a reference time factor $\alpha_t = (1+E)^t$, that is, $\vartheta = \sum_{t=1}^{T_2} \frac{\dot{\vartheta}}{(1+E)^t}$. Inasmuch as value ϑ is constant by year of summation according to "Methods" Appendix 2 $P_2 = \frac{E}{(1+E)^{T_2}-1}$, then

$$\vartheta = \sum_{t=1}^{T_2} \frac{\dot{\vartheta}}{(1+E)^t} = \dot{\vartheta}\frac{1-(1+E)^{-T_2}}{E} = \frac{\dot{\vartheta}}{P_2+E}. \quad (9)$$

Then, having substituted expression (9) for (8) and regrouping the members more conveniently, they give the final formula[6]:

$$\vartheta = \left[3_1 \frac{B_2}{B_1} \cdot \frac{P_1+E_н}{P_2+E} + \frac{\left(H'_1\frac{B_2}{B_1} - H'_2\right) - E_н\left(K'_2 - K'_1\frac{B_2}{B_1}\right)}{P_2+E} - 3_2\frac{P_2+E_н}{P_2+E}\right]. \quad (10)$$

In their opinion, the national economic impact of the production and use of new equipment throughout its service life[7] should be determined using formula [10]. It is also clear from this formula that, given $E_н = E$, it reduces to formula [4] of the "Methods." The authors point out that calculating the impact using formula [4] of the "Methods" yields a negative error which is a function of service life T_2.

L. Blank and K. Velikanov think formula [4] incorrectly replaces capital investments on machinery acquisition with reference expenditures on its manufacture, since the basis of capital investments is the wholesale price of the machinery, which differs from the amount of reference expenditures on its production; moreover, reference expenditures do not include expenses on delivering and installing machinery.

In this same formula [4] of the "Methods," current consumer expenditures H'_1 and H'_2 for all years of base and new equipment operation are accepted without change. In this connection, /I. Finkel'/ (Ul'yanovsk, UNIPTIMash [expansion unknown]) makes the interesting observation that growth in the economic impact of new equipment occurs gradually, beginning with losses in the initial years of new equipment utilization, reaching a maximum, and then beginning to drop quite sharply to a branch-average level and lower, inasmuch

as the demand for current maintenance and equipment servicing increases. This contradiction obviously dictated V. Vybornov's idea that the basic formula for calculating national economic impact must possess a high degree of standardization and correlation.

Further, K. Velikanov writes that, based on the necessity of ensuring comparability of the variants in terms of amount of output produced, value $З_1$ in formula [4] is multiplied by a coefficient of productivity growth for a unit of new means of labor which is equal to the ratio of annual output (work) amounts produced when a unit of base and new means of labor $В_1$ and $В_2$ is used, respectively. This procedure for making the variants identical in terms of output volume can lead to distortion of the amount of capital investments required under the base variant. The amount of investment does not change continuously, as a function of the means of labor productivity growth factor being examined, but spasmodically, inasmuch as the investment amount is calculated in accordance with the requirements for means of labor, which is most often an integer.

L. Blank notes that in formula [4], multiplying reference expenditures for base equipment by a coefficient of change in the service life of a new means of labor $\frac{P_1 + E_н}{P_2 + E_н}$ yields an impact value which differs from that obtained when calculating repeated expenditures for all cycles of base and new equipment service life, with a corresponding discounting of them.

One methods innovation introduced into practice for the first time by the "Methods" is the calculation of renovation rates according to the formula: $P = \frac{E}{(1+E)^t - 1}$. In this instance, the annual total renovation contributions will be somewhat less that the total deducted in economic practice. L. Blank, proceeding from the fact that capital investments on the acquisition of machinery are generally effected through the state budget, thinks they should therefore be viewed as "interest-free loans" which the enterprises repay in equal amounts throughout the service life of the machinery in the form of monthly deductions for renovation. He concludes from this that, if the time factor is considered, deductions for renovation should be increased. However, in the end, he comes to the conclusion that that need not be done, inasmuch as profit from the use in the national economy of renovation deductions for the service life of the machinery should actually be viewed as the reimbursement of loss from "interest-free loans."

An attempt is made in the new "Methods" to link the national economic impact of new equipment to the actual cost accounting of the enterprise. However, K. Velikanov, while agreeing that, under the existing system of enterprise and association cost accounting, it is precisely the profit increment which is the new equipment impact which is actually being calculated and taken into account, writes: "What relationship does this increment in profit above the normal profit have to saving aggregate social labor, the achievement of such economy having done the most to create new equipment and improve

existing equipment?!" In his opinion, those who think that the profit increment of an enterprise, branch or ministry is the same as the national economic impact, which is identical to the economy in aggregate social labor, making the maximum such profit the sole grounds for choosing the directions of national economic branch development and solution variants for specific production tasks, are mistaken.

/V. Likhachev/ (Izhevsk) notes that nothing is said in the "Methods" about the revenue obtained by the enterprise from the marketing of base equipment (K_p). That revenue, in his opinion, need not be found from the amount of capital investments needed to introduce new equipment, inasmuch as the old equipment is generally sold after the new has been introduced. That revenue goes into the production development fund and is a source for subsequent investments in new equipment. V. Likhachev therefore proposes that the revenues from selling old equipment, calculated with consideration of the time factor and multiplied by a normative effectiveness factor $E_н K_p$, be added to the profit of the corresponding year.

A number of authors raise in their remarks certain organizational-legal questions of the operation of the new "Methods." Introduction of the new "Methods" must, in V. Markelov's opinion, also entail a review of the bonus scales for the creation and introduction of new equipment. Increasing the impact estimate period from one year to a number of years equal to the service life of the new equipment in and of itself leads to an increase in the impact. V. Markelov notes that if the annual economic impact is calculated using the formulas given in the "Methods" for new means of long-term application labor with improved qualitative characteristics (either for the production and use of new objects of labor or for improved ones), then the impact obtained will very often exceed several-fold the two-million ruble mark (calculations of an impact higher than this are agreed to by the USSR Council of Ministers' State Committee for Science and Technology), although the technical-economic indicators of the new equipment exceed the indicators of the equipment being replaced by only 30-50 percent. Such considerable economic impact amounts should be explained by the fact that, under the previously existing methods, the economic impact was determined as if it were obtained in a single year, while under the new "Methods," (Point 13), the impact is determined over the entire service life of the new equipment. Naturally, in this case the total economic impact increases significantly, while the bonus scale remains unchanged.

I. Finkel' raises an important problem associated with introducing the new "Methods": when plant specialists who do not recognize the technical-economic indicators for the base variant, regardless of whether they were calculated on the basis of branch time norms or the achievements of a leading enterprise producing similar output, are encountered when confirming actual effectiveness. Designers sometimes intentionally or unintentionally strive for a situation in which one indicator (reference expenditures on the base variant) is increased to a maximum value and another (reference expenditures for the variant being planned) is reduced to the minimum value possible. Therefore, in

I. Finkel'a opinion it is important to establish scientifically substantiated rules for calculating the economic effectiveness of introducing new equipment, to increase responsibility and introduce fines for artificial under- or overstating of an economic impact, for new equipment consumers' evading confirming that impact.

In what ways must the methodology of determining the economic effectiveness of new equipment be improved? An increasing number of scientists and practicing economists consider it appropriate to create a single method for determining social production effectiveness, a method which would regulate the resolution of various economic and technical decision-making tasks on a uniform methodological basis.[8]

The necessity of integrating the numerous methods materials on determining the comparative economic effectiveness of variant resolutions of specific economic-production and technical tasks with a view towards selecting the most efficient among them has been substantiated in detail by K. Velikanov. He notes that, given two official methods, the "Standard Methods of Determining the Economic Effectiveness of Capital Investments" (1969) and the new "Methods" (Basic Provisions, 1977), their spheres of application and their "subordination" have not been clarified. The main thing is that the methodological principles of these methods differ greatly from one another, while the selection of the best variants for using national economic resources must be built on unified fundamental principles. Therefore, K. Velikanov proposes the immediate organization of involvement of broad segments of the scientific community in the creative development of unified Methods of determining the comparative economic effectiveness of socialist production development variants and variants of the use of its resources. It would be expedient, in his opinion, to draft such methods after a preliminary local review, submitting that draft for discussion at an all-union conference such as was held in 1958 to discuss the basic provisions of the first "Standard Methods of Determining the Economic Effectiveness of Capital Investments and New Equipment in the National Economy."

The new "Methods" were developed on the basis of research done by academy and branch institutes. It takes into account the results of a discussion of the problems of economic effectiveness by the scientific community and production workers. The "Methods" reflect the state of the theory of capital investment and new equipment effectiveness, so we are foremost interested in evaluating experience in applying the "Methods" and in discussing its individual provisions in order to continue perfecting the theory and methodology of determining effectiveness.

Let's concentrate on calculations of the annual economic impact of the production and use of new means of long-term application labor according to formula [4] in conformity with Point 13. There is good reason for the interest in Point 13 of the "Methods," inasmuch as it is a new and fundamentally important point which was absent from previous methods.

The importance attached to expanding the planning horizon is known. There was a contradiction between this demand and the accepted methods of evaluating the comparative effectiveness of economic and technical resolutions -- the latter were static in nature and were oriented towards determining the annual economic impact. The "Methods" for the first time add a dynamic modification to the static formula of reference expenditures. In this connection, those letter-writers who think the impact estimated using formula [4] is not an annual impact in the generally-used meaning of the term, but the impact of the annual release of new equipment over its entire service life, are correct. Naturally, the national economic impact of new equipment must be calculated using the same formula by both its producers and its consumers, on the basis of the exact same indicators and yielding the exact same value; otherwise, it does not justify the "national-economic" label.

In connection with Point 13 of the "Methods," K. Velikanov thinks the actual amount of output produced using the new equipment in the corresponding year of its use must be adopted as the basis for calculating economic impact. However, this problem is not solved so indisputably and unambiguously. The fact is that the "Methods" are intended to resolve various tasks (wherein lies their advantage), including selection of the best variants of new equipment and bonuses for its creation and introduction. In order to solve these tasks, it is important to know the amount of the anticipated impact from all new equipment being produced, its economic potential. As concerns its planned and actual impacts, they must be determined for the amount of equipment actually being used, as outlined in the "Methods" (Section III).

Let us recall that, in connection with this same Point 13, L. Blank is against dynamic methods of calculating expenditures and results for individual local-scale new equipment introduction measures in principle. In our view, he greatly exaggerates the difficulties in making them and the size of the possible error, although such difficulties do exist objectively. One can hardly agree that the accuracy of the economic parameters forecast increases with the transition from single small-scale technical measures to larger projects such as scientific-technical and economic programs. Experience shows that a forecast of the expenditures associated with the production and use of new tractors, excavators and machine tools turns out to be more accurate than, for example, a determination of the estimated cost of implementing large-scale projects and programs.

Moreover, the present apparatus for forecasting the economic parameters of equipment was developed applicable to individual types of equipment, and not to large-scale scientific-technical systems. In combination with the use of methods of recording indeterminacy in decision-making, continued improvement in the methods of forecasting the economic parameters of individual types of equipment and large technical systems (including the process of calculating long-term economic impact) will undoubtedly enable us to overcome the existing difficulties. As concerns the "variable base," however, increasingly improved types of equipment will naturally be created in the scientific and technical development process. But the process of selecting equipment and

planning its introduction is also continuous. Clearly, equipment introduced in 1978 because its indicators exceed those of the best domestic or foreign equipment when it was developed will in 1988 have indicators inferior not only to the best of that time, but also to many intermediate types of identical-purpose equipment. But it does not follow from this that we need to reject its introduction in 1978 and use even older equipment while waiting for 1988 or, due to the variable base, avoid calculating the long-term impact, as that is needed to make correct decisions under the conditions of the information available at any given moment.

V. Vybornov does not see the economic sense of adding renovation norms and the effectiveness normative $P+E_н$. This is related in part to the fact that, when deriving formula (4), he formally divided both parts of the transformed expression (3) by $P_2+E_н$, or, which is the same thing, multiplied them by $\frac{1}{P_2+E_н}$. The economic essence $\frac{1}{P_2+E_н}$ becomes clear from the transformations of Ya. Rips and B. Savel'yev, as from formula (9), for example. That is the total discount multipliers for annual expenditures (if constant) over period T_2, that is, over the service life of the new means of labor; similarly, $\frac{1}{P_1+E_н}$ is the total such multipliers for the service life of the base means of labor (T_1). But fraction $\frac{P_1+E_н}{P_2+E_н}$ signifies nothing other than the relationship of this total for a new means of labor to its value for the base means, called the "coefficient of recording change in the service life of a new means of labor as compared with the base means" in the "Methods."

Formula [4] of the "Methods" and its derivation provided by V. Vybornov are strictly correct only given the assumption that the normative of comparative capital investment effectiveness and the discounting norm are essentially the same indicator, or in any case are the same value. Otherwise, one component, consumer savings, is adduced based on a normative equal to effectiveness coefficient $E_н$ and another component which takes renovation deductions into account in accordance with Appendix 2 is adduced based on normative E, which differs from $E_н$, in one and the same formula. In this instance, formula (10), obtained by Ya. Rips and B. Savel'yev, is easily derived instead of expression [4]. However, that derivation only formally confirms the imprecision (given the above-noted requisites) of expression [4]. In fact, use of the discount norm E in the formula of renovations $P_2 = \frac{E}{(1+E)^{T_2}-1}$ is doubtful.

A. Lur'ye, having substantiated such a method of calculation renovation when comparing plan variants, proceeded from a unified concept of the effectiveness normative (which he called the discounting norm). "To correctly compare variants," he wrote, "...expenditures to recompense worn-out fixed assets must...be equated to such annual expenses which will, over τ years (the service life of fixed assets), together with losses in possible savings,

comprise a sum equal to the cost of the fixed assets. Thus, in order to determine the amortization deductions, which we have designated A, we obtain

$$A = \frac{E \cdot K}{(1+E)^t - 1}, \quad [9]$$

Apropos of L. Blank and K. Velikanov's ideas about substituting reference expenditures on machinery manufacture for capital investments on machinery acquisition in formula [4], let us note the following: replacement of the wholesale price of machinery with reference expenditures on its manufacture permits a more precise evaluation of its national economic impact as a savings of social labor expenditures. When distribution prices are used, the size of the impact of a machine become dependent in considerable measure on the difference between the amounts of profit for base and new equipment included in the prices. Incidentally, the State Price Committee of the USSR Council of Ministers replaced base item prices with reference expenditures on their manufacture in the "Methods of Determining Wholesale Prices for New Production-Technical Output" (1974) for calculating the upper limit of prices for new equipment, taking into account the known shortcomings in price formation.

As regards K. Velikanov and L. Blank's observations apropos of including methods of making the net result identical in calculation formulas [4] and [5], our viewpoint is that such inclusion is undesireable. It complicates calculating the economic impact because making the base variant identical to the net result does not always yield a whole-number resolution (which was pointed out by K. Velikanov) and because it is impossible to detect the savings in hypothetically constant current and capital expenditures. It must be added to this that there actually is a discrepancy, as L. Blank notes, between the value of the impact obtained using formula [4] when multiplying reference expenditures for base equipment by the coefficient of recording change in the service life of a new means of labor $\frac{P_1 + E_н}{P_2 + E_н}$ and that value of it which is obtained by direct calculation of repeated expenditures for all cycles of the service life of base and new equipment with their corresponding discounting. It once again results from the fact that in the second case, the discounting norm E is used and differs from the effectiveness normative $E_н$. Given identical $E_н$ and E values, the calculation results coincide.

This can be illustrated by the following numerical example. A new means of labor which differs from the base means in only two indicators -- service life and expenditures on its manufacture -- has been developed. All other indicators of the base and new equipment are assumed to be identical, for the purpose of eliminating their influence on the calculation results. [Chart on page following.]

Indicators	Base equipment	New equipment
Reference expenditures on manufacturing the means of labor (З), in rubles	500	1,000
Its productivity in physical units per year	2,600	2,600
Service life (T), in years	5	20
Renovation norm at the same service life, according to "Methods" Appendix 2 (P), in proportion of one-time expenditures	0.1638	0.0175
Current customer expenditures (И'), in rubles	80	80
Concomitant customer capital investments (К'), in rubles	100	100
Production of the new means of labor per year, in units	--	320

Calculation of the national economic impact based on the indicated initial indicators provides the following results using formula [4]:

$$\Э = \left[З_1 \cdot \frac{B_2}{B_1} \cdot \frac{P_1 + E_н}{P_2 + E_н} + \frac{(И'_1 - И'_2) - E_н (К'_2 - К'_1)}{P_2 + E_н} - З_2\right] \cdot A_2 = \left[500 \cdot \frac{2\,600}{2\,600} \cdot \frac{0{,}1638 + 0{,}15}{0{,}0175 + 0{,}15} + \frac{(80 - 80) - 0{,}15(100 - 100)}{0{,}0175 + 0{,}15} - 1\,000\right] \cdot 320 \approx -20\,800 \text{ rubles;}$$

with the addition of repeated expenditures discounted at E = 0.10:

$$\Э = \left\{\left[500 + \frac{500}{(1 + 0{,}10)^5} + \frac{500}{(1 + 0{,}10)^{10}} + \frac{500}{(1 + 0{,}10)^{15}}\right] - 1\,000\right\} \cdot 320 \approx +39\,328 \text{ rubles;}$$

with the addition of repeated expenditures discounted at E = 0.15:

$$\Э = \left\{\left[500 + \frac{500}{(1 + 0{,}15)^5} + \frac{500}{(1 + 0{,}15)^{10}} + \frac{500}{(1 + 0{,}15)^{15}}\right] - 1\,000\right\} \cdot 320 \approx -20\,800 \text{ rubles.}$$

The whole series of formulas used in the "Methods" is based on those concepts of effectiveness for which the discount norm is accepted in principle as being equal to the effectiveness normative. Thus, many shortcomings of formula [4] stem from the rejection of that principle and the introduction of different values for the effectiveness normative and the discount norm.

It seems to us that the next editing of the "Methods" should replace formula [4] with a more universal formula for calculating the cumulative (integral) impact over the service life of the equipment, a formula not linked to the firm condition that the amount of current expenditures in operating base or new equipment be constant for all years of its operation. The principles for determining the national economic cumulative impact have been substantiated in the works of A. Lur'ye, V. Novozhilov, T. Khachaturov, L. Gatovskiy

and other Soviet economists, and the appropriate formulas are contained in the "Basic Provisions for Optimizing Production Development and Distribution" which were prepared by the USSR Academy of Sciences Siberian Department's TsEMI and IEOPP [expansions unknown], jointly with the Council for the Study of Productive Forces attached to the USSR Gosplan, as well as in the "Methods of Determining the Economic Effectiveness of New Equipment," worked out by the USSR Academy of Sciences' Institute of Economics in 1973. Some of the remaining disputed methods questions of calculating cumulative impact could be resolved through discussion. As concerns making the end result identical, however, separate methods having been included in formulas [4] and [5] of the "Methods," that obviously must precede calculation of the impact.

Among the merits of the "Methods" not noted by the authors cited here are the inclusion in it of a new section, "Reflecting the economic effectiveness of new equipment in norms, normatives, planning and reporting indicators," which is called upon to establish a link between the national economic impact of new equipment and the cost-accounting results of enterprise activity. It attempts to introduce into the management of scientific and technical progress three varieties of the impact calculated on a single methodological basis: anticipated (plannned), planned and actual.

K. Velikanov's ideas about the "Methods," that the increment in profit from the replacement of base equipment with new equipment is considered to be its national economic impact and that the maximum such increment be considered the criterion for decision-making, seem to us to be without foundation. They do not follow at all from either the text of the methods or from published commentaries on it.

Point 4 of the "Methods" states: "Decisions on the expediency of creating and introducing new equipment, inventions and efficiency proposals are made on the basis of the economic impact as determined by the level of production of the new equipment in the calculation year (annual economic impact)." But Point 6 clearly states that "the annual economic impact of new equipment (inventions and efficiency proposals) is the total savings of all production resources (live labor, materials, capital investments) the national economy receives as a result of the production and use of new equipment and is in the final analysis expressed in increased national income."

Thus, the "Methods" anticipate decision-making on the basis of the national economic impact as the total savings of all production resources, which is essentially very close to K. Velikanov's savings of aggregate social labor. As concerns profit and other indicators of enterprise economic activity, however, according to the "Methods," the national economic impact of new equipment must be reflected in the planned and actual values of these indicators.

This signifies, first, a precise subordination of the national economic and cost-accounting impacts of new equipment: decisions are made on the basis of the national economic impact, which is only reflected in the cost-accounting impact. Second, the "Methods" obviously proceed from the fact that the

prices for new equipment are set in accordance with the "Methods for Setting Prices for New Production-Technical Output." The interaction of these two methods is an essential condition for the planned management of scientific and technical progress. The increment in the profits of the producer and consumer of new equipment, as has been proven in the works of L. Gatovskiy, M. Vilenskiy, D. L'vov, A. Koshuta and others, is two parts of its national economic impact.

From our point of view, neither can we agree fully with V. Likhachev's proposal (p 8). In this case, revenues from the sale of base equipment affect the results of enterprise cost-accounting activity but find no reflection whatsoever in the national economic impact indicators as calculated using formulas [3], [4], [5] or [7]. Moreover, the use of these funds to acquire any other new equipment as a consequence becomes the subject of another calculation of the economic impact of introducing that (other) new equipment. It seems to us that the indicated revenues, which increase the capital investment funds of society, should still be deducted from capital expenditures on new equipment when calculating the national economic impact with consideration of the time factor, as V. Likhachev proposes, but when determining the cost-accounting impact -- without such consideration (as applicable to the year of sale) for base equipment.

Finally, L. Blank's proposal on calculating renovation. It must first be noted that the method of calculating renovation adopted in the "Methods" is intended only for calculating the anticipated (designed) national economic impact and has nothing whatsoever to do with actual economic relations between the state and the enterprise. This is a calculation method having as its goal ensuring a stricter comparability of variants and the possibility of evaluating them economically in an objective manner. The opinion about reciprocal compensation of interest charges between the state and the enterprise is also without foundation for that reason. Moreover, from our point of view, L. Blank incorrectly interprets renovation contributions as paying off a state loan for the acquisition of new equipment. In fact, depreciation deductions (including renovation) are a method of transferring the cost of means of labor to the product produced, ensuring reimbursement of means of labor after their full depreciation. This incorrect interpretation of the essence of renovation also predetermines errors in the formal apparatus: instead of referring renovation deductions based on a time factor to the last year of operation of the machine, L. Blank proposes referring them to the year of its initial acquisition, and consequently would not reduce the norm of deductions for renovation, but would increase them as compared with the norm accepted in economic practice.

In conclusion, it should be noted that one very important direction in improving the methodology of determining the effectiveness of new equipment which was not reflected in reader letters and observations was the search for methods of calculating its socioeconomic impact, which must in time replace the indicator of economic impact in resolving tasks of managing scientific and technical progress.

FOOTNOTES

1. Approved by the USSR Council of Ministers State Committee for Science and Technology, the USSR Gosplan, the USSR Academy of Sciences and the USSR Council of Ministers State Committee for Inventions and Discoveries on 14 February 1977.

2. For the sake of brevity, we will subsequently use "Methods" to signify these particular methods.

3. In order to distinguish "Methods" formula numbers from those in this review, we are enclosing the former in brackets and the latter in parentheses.

4. This viewpoint is close to V. Krasovskiy's position presented in his article "Integral Impact and the Time Factor" (VOPROSY EKONOMIKI, No 8, 1974, p 8).

5. See: EKONOMICHESKAYA GAZETA, No 10, March 1977, supplement; B. Zaytsev, "Determining the Effectiveness of Technical Innovations" (VOPROSY EKONOMIKI, No 10, 1977).

6. The authors reduce values H'_1 and K'_1 in the formula to the amount of output for the new means of labor by multiplying them by $\frac{B_2}{B_1}$.

7. The reference is to the impact of a single unit of new equipment; according to the "Methods," this expression should be multiplied by A_2, the amount produced by the new equipment, in order to determine the annual release impact.

8. See, for example: VOPROSY EKONOMIKI, No 6, 1978, p 121.

9. A. L. Lur'ye, "Ekonomicheskiy analiz modeley planirovaniya sotsialisticheskogo khozyaystva" [Economic Analysis of Socialist Economic Planning Models], Nauka Izd-vo, 1973, p 335. The symbols adopted by A. Lur'ye have been retained; they correspond to the following symbols used in the "Methods" and in this review: $\tau = T_3$; $E = E_н$; $A = P_2$.

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END